ANNUAL STATISTICAL NUMBER

AVIATION

The Oldest American Aeronautical Magazine

A McGraw-Hill Publication MARCH, 1931 Price 50c. per copy

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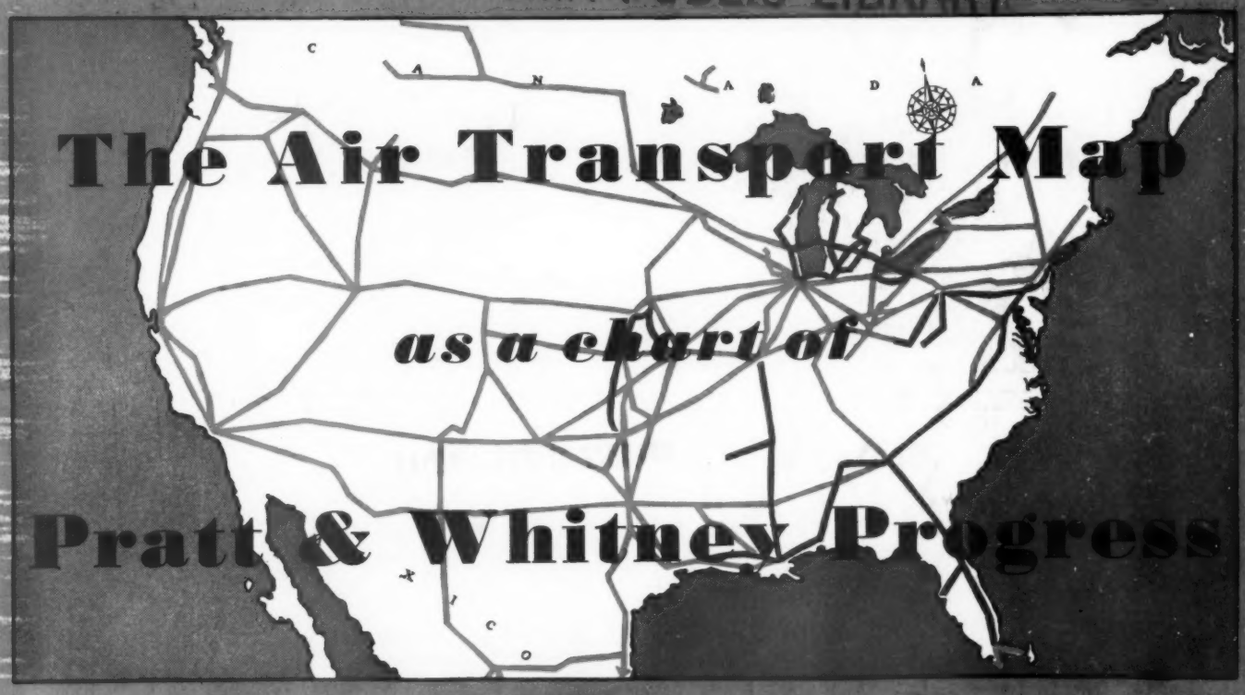
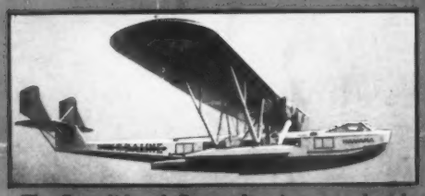


The Boeing 40-B-4, for passengers and mail is powered with a Pratt & Whitney "Hornet"

On the air transport map above, lines using Pratt & Whitney engines are shown in red. Other lines are indicated in blue. Airplane manufacturers and air transport operators can offer no more convincing proof of dependability than to say: "These planes are powered by Pratt & Whitney."

The new high speed Ford is powered with three "Wasp" engines



The Consolidated Commodore is powered with two "Hornets"

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The Fokker F-10 has three Pratt & Whitney "Wasp" engines

Wasp* & Hornet* Engines

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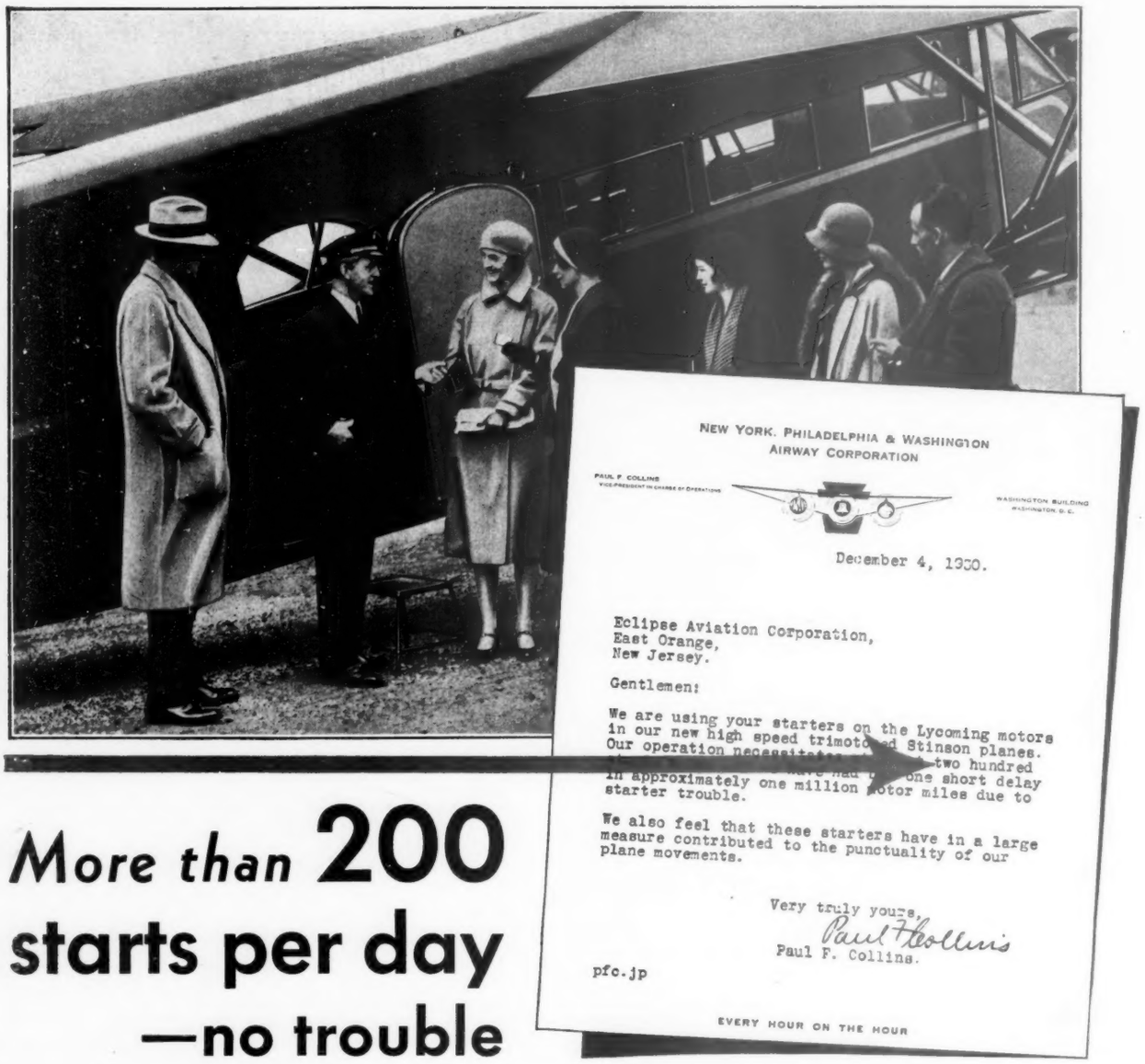

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AVIATION

A McGRAW-HILL PUBLICATION . . . EST. 1916

The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

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CONTENTS FOR MARCH, 1931

Volume 30, Number 3

Production and Licensing 136
Materials 150
Air Mail and Passenger Transportation 151
Airway Development and Accident Data 156
Aviation Law 157
Airport Operations and Improvements 158
Flying Schools 161
Aeronautical Finance 162
National Aeronautic Association 164
National Advisory Committee on Aeronautics 165
Weather Bureau 165
Canadian Aviation 166
Foreign Trade 168
Military and Naval Aeronautics 171
Foreign Aviation 173
Airplane and Engine Specifications 178

EDITORIALS 125

NEWS OF THE MONTH 129
TRANSPORT AND ENGINEERING 186
FLYING EQUIPMENT 189
SERVICING SHORT CUTS 192
TECHNICAL ABSTRACTS 193
NEW VOLUMES FOR THE SHELVES . . 194
THE BUYER'S LOG BOOK 195
SIDE SLIPS 196

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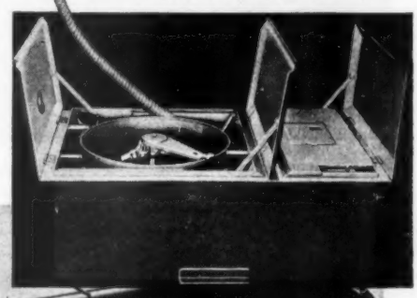

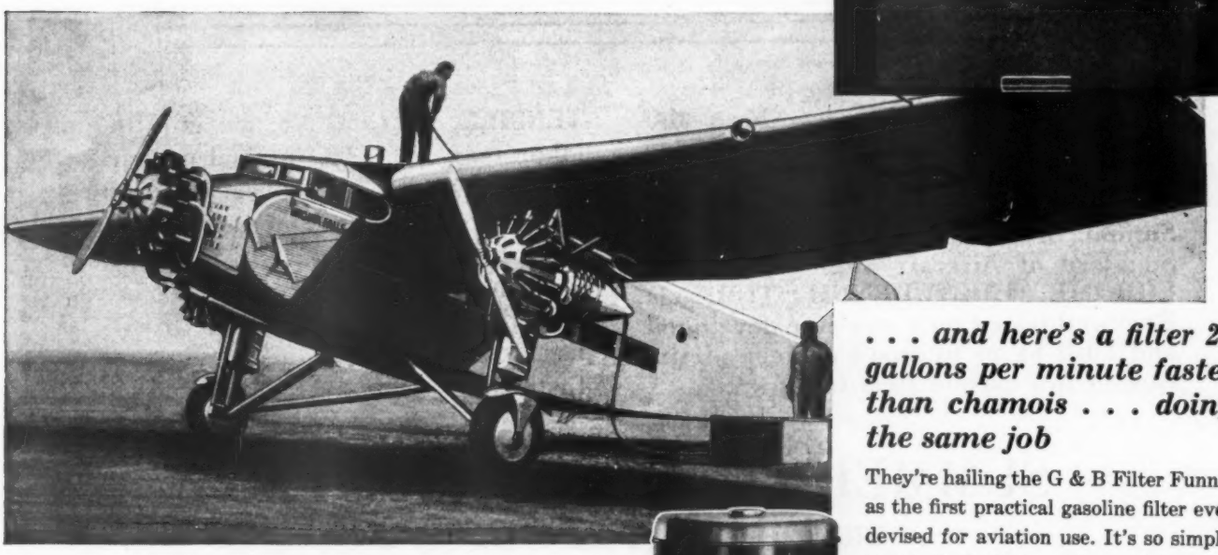

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They're hailing the G & B Filter Funnel as the first practical gasoline filter ever devised for aviation use. It's so simply constructed that you can thoroughly clean it in three minutes. Most important, it recovers all impurities and insures delivery of clean, water-free fuel.

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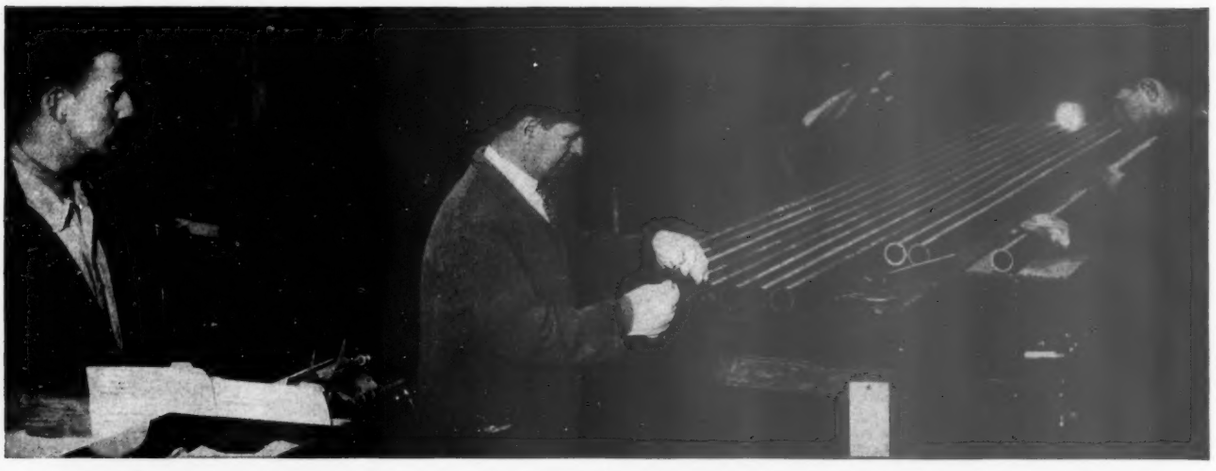

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Once Upon a Time....

There was a time when the most modern military aviation services were equipped with but one type of aerial camera. It had to supply the aerial photographs for all the military applications then understood.

This condition existed when photography from the air was new and untried for military purposes. A similar condition existed a few years earlier when military aviation itself was new and the most elaborately equipped air services could boast of but one type of military aircraft.

Any modern military air service today requires eight or more major classifications of airplanes, some of the major classes including several different types. The kinds of aircraft have increased because the effectiveness of aircraft for military purposes are greatly improved by designing a special model for each type of flying activity.

Just as the modern air service must have more than one class of airplane, it must have more than one type of aerial camera. Only in this way can the maximum military value of aerial photography be realized. Here also the design of special purpose equipment increases the effectiveness of an activity for military purposes.

Fairchild Aerial Camera Corporation alone has followed, in camera design, the same course that in aircraft design has been responsible for the greatly increased effectiveness of aircraft for military use. There is now a special model Fairchild aerial camera for every military application of aerial photography.

The Fairchild line of aerial cameras has increased since 1918, from one to twenty models. Air Services using Fairchild equipment do not have to depend on the same camera model for mapping photographs from extremely high altitudes, such as 30,000 feet, as for oblique photographs from low altitudes.

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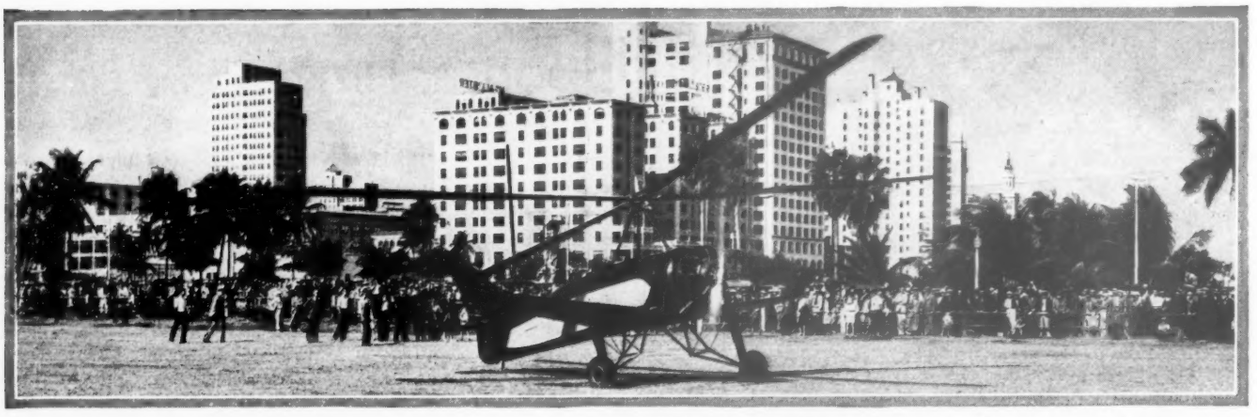
*ONE OF A SERIES OF ADVERTISEMENTS BASED ON STATEMENTS

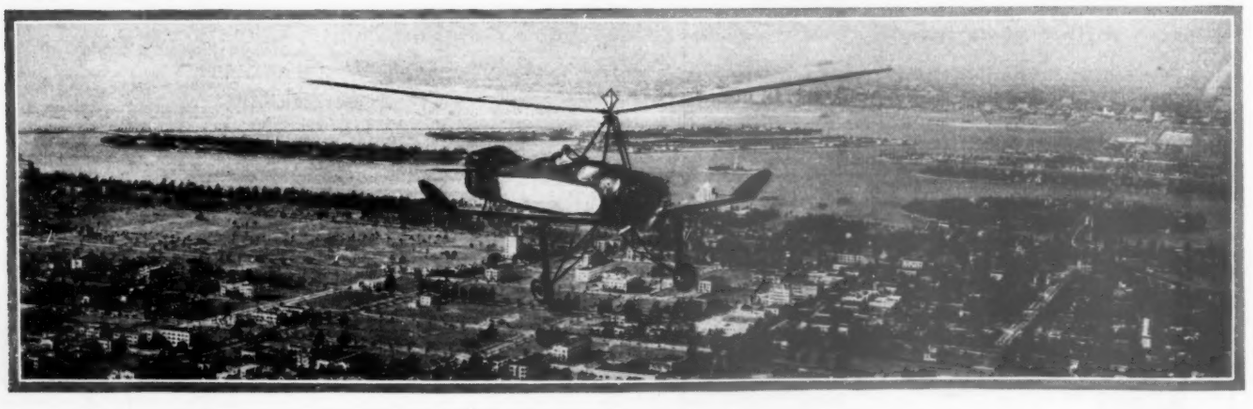


Above: Miami, Fla.—The Autogiro was the center of interest at the recent All-American Air Races and Navy Field Dedication

Above: Taking off from Bay Front Park, in the heart of Miami's hotel section. A striking illustration of the Autogiro's small area maneuverability.

Below: James G. Ray, veteran mail and test pilot, goes voyaging.

Below: Homeward bound from Miami to Pitcairn Field, Philadelphia. The trip included demonstration stops at several southern cities.



AUTOGIRO COMPANY OF AMERICA

BY RECOGNIZED AVIATION AUTHORITIES—NAMES ON REQUEST

"turn out something to fit the private owner-flyer"*

THE industry's outstanding sales opportunity is practically untouched. Not more than 2,000 aircraft in this country, according to the best available estimates, are privately owned and flown by their owners.

Large scale development of private ownership depends, however, upon the removal of limitations inherent in the conventional airplane of today.

There must be less dependence upon piloting skill, and consequent reduction of training time and cost.

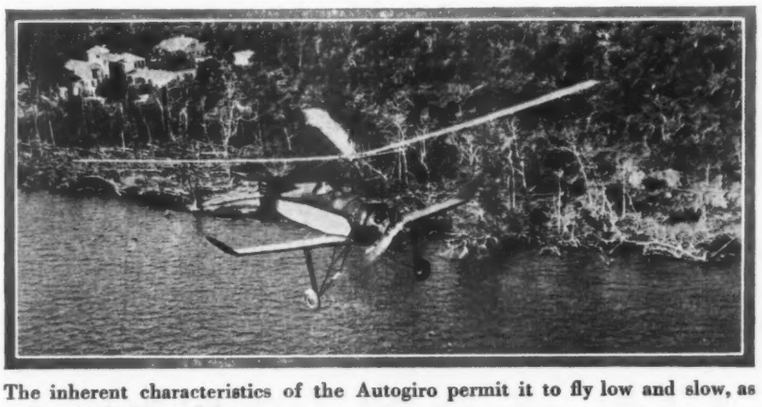
It must be possible to take off and land at very low speed, and to slow down or even stop in the air at will.

It must be possible to land almost anywhere in case of necessity.

By reduction of the area necessary for take-off and landing, it must be made possible for the moderate-sized suburban or country home to have its private field, and for public fields to be located closer to residential and business centers.

The Autogiro has demonstrated that it can be the means of meeting each of these requirements. It offers to aircraft manufacturers the most inviting opportunity in aviation history. We are prepared to acquaint the industry with Autogiro principle, design and construction—to arrange demonstrations and discuss production privileges.

The Autogiro Company of America is not a manufacturing or selling company. It is solely an engineering and licensing organization. It owns and controls, exclusively, all Autogiro patent rights in the United States. Manufacturing companies of high standing will be licensed to build Autogiros with the full co-operation of our engineering staff.



The inherent characteristics of the Autogiro permit it to fly low and slow, as well as high, fast and far.

AUTOGIRO

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CHARACTERISTICS

The Autogiro differs basically from all other heavier-than-air craft in the source of its lifting capacity. This lift is given primarily by four rotating blades which take the place of the familiar wings of an airplane. There is no time when this supporting rotation of the blades can be stopped while the machine is in the air, as their motion is produced solely by wind pressure caused by the movement of the Autogiro in any direction, climbing, level flight, gliding or descending vertically. The supporting rotation of the blades is entirely independent of the engine, whose sole function is to propel the Autogiro.

The Autogiro presents flying characteristics hitherto impossible. It can take off at low speed after a very short run, and immediately assume a steep-climbing angle. It can fly well over 100 miles per hour, or as slowly as 25 miles per hour. It can be brought momentarily to a standstill and hover. It can bank and turn slowly without fear of loss of forward speed. It can glide or descend vertically at a speed less than that of a man descending in a parachute, and with virtually no forward speed even with a dead engine. Above all, it cannot fall off into a spin from a stall. As a result, little operating skill is required.

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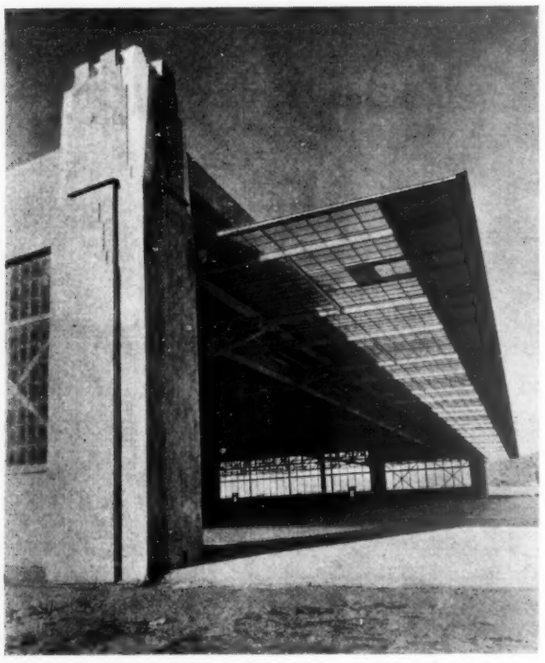

Austin Canopy Doors which permit any one or all doors to be opened or closed in 60 seconds in the 310x248 ft. Los Angeles hangar, designed, built and equipped by Austin for United Aircraft & Transport Corporation.

in the factor of doors alone they call for real engineering ability

A giant door 300 feet long . . . opening *within 60 seconds* at the press of a button . . . such an idea ten years ago would have been regarded as a Jules Verne fantasy. Yet such a door is not only possible, it is *in actual use today* on United Airport Hangar No. 3, near Los Angeles.

This startling innovation makes it possible for the entire sides of a hangar to become great steel doors with large sash areas . . . 300 or 3000 ft. . . . their operation is in no way affected by the width of the clear span opening. Such doors are composed of 25, 30, 50-ft. . . . sections which can be operated independently when desired. While open, these doors form a protecting canopy over the apron of the hangar, hence the name, Austin Canopy Doors.

But multiple are the Austin improvements in hangar engineering. Ship handling is expedited by clear floor areas . . . possible through cantilever which permits limitless expansion. Abundant daylighting . . . facilities for plane service . . . ample overhead clearance . . . steel, concrete and brick construction . . . pleasing architectural treatment . . . these are typical advantages.

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AVIATION
A McGraw-Hill Publication . . . Est. 1916

The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

VOLUME 30 . . . *March, 1931* . . . NUMBER 3

AGAIN COMES A STATISTICAL ISSUE

"STATISTICS", some one or other once disdainfully observed, "are only petrified facts."

The simile was meant to be anything but flattering, but we cheerfully accept it. It offers a very good description of the precise function of statistical analysis, which is to give knowledge solidity and permanence of form. Individual facts and bits of information are all too readily fleeting. When we have tabulated them and charted them and bound them between covers, they are available to be used as a permanent base of comparison, as the naturalist makes use of museum specimens in interpreting his observations in the field. Elaborate compilations, such as we made a year ago and such as we here present, are sometimes criticized for quickly getting out of date. Of course many of the figures that are recorded in these pages will be greatly changed within the next few months, but even if that were true of all of them their usefulness would not be wholly transitory. They furnish a standard and a background by which our progress may be judged and our forecasts made.

The general plan follows that of a year ago. A few new sections have been introduced; the subject of state air law, of steadily growing interest both to manufacturers and operators, has been given the attention that it deserves; accident hazard records have been more elaborately studied, and receive more space, than ever before; Canadian activities claim an enlarged attention, and they have been presented in a new and clearer form. Some of the material heretofore included has been omitted, not because it was lacking in usefulness but because those particular data would have changed but little within the past year, and no space has been assigned to mere repetition of what was set forth a year ago. Those who have occasion to seek such information can turn back to last year's statistical issue to find it. The present compilation does not in every detail supersede that of a year ago, and in particular many figures on the activities of several years back have been omitted to make room for more elaborate analyses directly affecting the industry's present position.

A great many conclusions have been drawn that were quite out of reach in the early months of 1930, for they necessarily depended upon an exhaustive comparison of the situation at two different periods. At that time no material for such a comparison existed. By using our own studies of last spring in connection with those just made we are in a position to give some definite information on the life of airplanes, on which sections of the country are gaining in relative importance as aircraft markets, and on other points on which we could heretofore have offered only the vaguest speculation.

The general plan and purpose remain very much as they were last March, when they seemed to meet with a gratifying measure of approval. The scope and variety of content have been increased, and will be increased in future issues as far and as rapidly as the data available permit.

We ourselves look forward with a lively interest to each annual reappearance of the statistical number, and

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with a lively curiosity to see what the labor of compilation and analysis will bring forth. Anticipatory interest lightens the task of preparation. A task it undeniably is, and a heavier one than can easily be recognized by anyone who has not actually undertaken a similar piece of work on his own account. There are single figures in these tables, and single points upon some of these curves, each of which represents several hours of search and computation;—yet before that work was done the figures did not exist anywhere, and they had a unique value for our present purposes. Without their tedious evaluation, the statistical record of the status of American aviation could not have been complete.

Although a very considerable part of the information here assembled represents our own collection directly at the source, the major portion has been obtained by the courtesy of official or semi-official organizations. For the form of presentation and the interpretation, as well as for such estimating as has been necessary to fill the gaps, we take full responsibility, but we have gratefully to acknowledge the most generous assistance from governmental departments and trade associations, both here and abroad. We cannot undertake to name them all in detail, but our very special appreciation is due to the Aeronautics Branch and Aeronautics Trade Division of the Department of Commerce, which have been prodigally generous with special compilations whenever requested; to the Aeronautical Chamber of Commerce; to the Post Office Department; to the National Advisory Committee for Aeronautics; and to the civil aviation authorities of Canada. All of them have taken particular pains to provide the most complete data possible on all acitivities within the field of their interest. Almost all of the approved, and many of the unapproved, flying schools, have taken the trouble to provide full details on their own operations. Grateful acknowledgment is made, also, to the War and Navy Departments, to the Weather Bureau, and to the National Aeronautic Association, together with numerous foreign governments that have made special report of the development of their own work in form suitable for presentation here. The directorate of Imperial Airways have co-operated most effectively in securing up-to-the-minute data on air transport in Great Britain.

Again, as in the past, we have to acknowledge our indebtedness to the standard annual publications, and most especially to the Annual Report on the Progress of Civil Aviation of the British Air Ministry, "L'Année Aeronautique," "Deutsche Luftfahrtsstatistik," the "Statistica delle Linee Aeree Civili Italiane," and to Henri Bouché's League report on the economics of air transport.

In putting forward this compilation of figures and facts drawn from many sources we repeat the invitation given last year to call attention to any errors in order that they may be corrected in a subsequent issue of the magazine, and also to offer suggestions for improvement next year. We have profited greatly by the comments of our readers in planning the 1931 statistical issue, and we trust that the beneficial results are plain, but we shall be quite satisfied if its reception by the industry is as favorable as was accorded its predecessors.

MAR-VEL-OUS!

IF THOSE interested in American air transport have ever had reason to hesitate about discussing the safety of their operations, the time for such timidity is past. The report on transport accidents in the year 1930 has destroyed the last shadow of occasion for being apologetic, or for changing the subject when conservative business men ask "just how dangerous this flying thing is, anyway."

The record speaks for itself. More than 30,000,000 miles flown. A total passenger-mileage of over 100,000,000. And only 26 fatalities. Nowhere, either in the eastern or the western hemisphere, has there ever been anything like that before. Various European airlines have gone through a period of years without accident, but the volume of their operations has been insignificant compared with that of the American companies. American air transport operators handled, in this single year, a passenger traffic exceeding the total carried under the flag of any one European country from the end of the War down to the present day. The pasenger-fatality rate on American airlines in 1929 was a third lower than had ever been realized on any European line or group of lines with anything like the same volume of activity. The American figure for 1930 beat the record of the previous year by another 20 per cent.

But there is more to come. Good as the record in 1930 was, it was marred by two accidents within a few days of each other in the first weeks of the year. If we break away from the calendar year and choose an arbitrary time interval for comparison, we get safety figures more extraordinary still.

For the one-year period from Feb. 1, 1930 to Jan. 31, 1931, American passenger services have had just three accidents in which passengers were killed, with a total of eight passenger-deaths. They have been showing almost 15,000,000 passenger-miles per fatality over that period, a record about six times as good as any that has ever been made in any European country over any reasonably large volume of operation. To those who are in the habit of chanting the praises of European air transport on every occasion, and for the people who fly between Paris and London but who never have been in an airplane on the western side of the Atlantic, we have the perfect answer. We can point to the figures not merely with pride but with the most fervent exultation. Let sceptics gaze upon them and be silent.

Obviously, this sort of performance is not put on by accident. There is a certain measure of good fortune about it, at least to the extent that it will be impossible

absolutely to count on making an equally sensational record this year, but that is a minor element. The amazing progress of the last eighteen months stands to the credit of the transport companies. It is a reminder of the exceptional morale of their personnel, the extraordinary skill of the typical transport line pilot and the care that is taken in selecting him, and of minute attention to detail on the part of all the operating personnel.

Quite as much, and perhaps even more, this spectacular reduction of hazard is to the credit of the Aeronautics Branch of the Department of Commerce. While we have not been in complete accord with each and every one of the stipulations imposed and enforced under Secretary Young's direction (no two people could be expected to agree exactly on the best course of action), the Department's work has to be judged by the over-all effect. The over-all effect is that we have stopped having accidents. The systems of operation, administration, and governmental regulation that have contributed to that result have proven themselves good. Their performance needs no extenuation.

BEAUTY

AND THE BEAST

IN THAT story of our childhood days the beast was, as everyone will admit, a custom-built jackass, specially designed in unlovely form in order to meet the most outstanding need of the moment, that of making a pretty little fairy story possible. But custom-building is not limited to the pages of Hans Christian Anderson, nor to the animal kingdom. We may well turn our own thoughts to the matter of custom-building airplanes for industrial uses as well as for the accommodation of the luxury flier. Planes of specialized commercial design might not be as lovely to look upon as are some of our present models, and would not be as swift. But the beast in the story was in reality a prince who eventually made everyone wealthy and happy, and the freight-carrying plane, even though it be prosaic in appearance, has the power of performing those same charming services for its users.

An airplane has two outstanding characteristics. It is faster than any other vehicle, and it can go to places that no other vehicle can reach, by routes which no other vehicle can follow. Because it costs more to operate the airplane than it does most other transportation units of like size, and because the airplane is definitely limited as to the loads which it can transport, it is necessary that we put the airplane to work at jobs for which it is suited. But before we can do this we must provide a vehicle of special design for the work to be done. There are endless variations of the commercial automobile, and so must there be of the airplane. It is no more reasonable to expect that we can toss the cushions out of a plane and put it to work hauling freight at a profit than to attempt the same thing with our Cadillacs or Marmons.

Now is a good time for airplane factories and their engineers to expend time and trouble in determining the special needs of various industries and in building air vehicles to meet them. Florists, miners, bankers, ranchers, and many other groups could use airplanes to better advantage than at present if those planes were tailored to fit the particular needs to be served. Custom-building need not be for beauty alone. Designers should make it their business to analyze the needs of all important groups of potential customers, with a view to building specialized airplanes for specialized utilization.

BOMBING

THE PEDESTRIAN

PEDESTRIANISM has become an increasingly hazardous occupation during recent years as a result of automotive activity. It will grow no less dangerous if tools, engine parts, and miscellaneous articles start raining from the sky. The cause of aviation will not be helped if aircraft increase the hazard not alone to the man in the street, but also to the family in the home. It is perfectly possible for articles to drop from airplanes. Not long ago, in fact, newspapers recorded three such incidents of a rather spectacular nature within a period of one week. In two cases, engine parts were announced to have dropped into houses. In the third case the entire airplane landed on the house and set fire to it, the owners barely escaping with their lives. The increasing frequency of such occurrences, a natural result of placing more aircraft in operation, becomes alarming.

The aviation industry should be the first to recognize and face this particular problem. If "accidents" of that sort continue, restrictive legislation will be promulgated by cities and states. Already, all flying over London has been prohibited. If such an example were widely followed in the United States the aviation industry would suffer a severe set-back.

Only a general recognition of the gravity of this problem and a willingness on the part of the individual operator to contribute his share toward its solution will be adequate. An obvious corrective factor is to avoid thickly settled areas when possible, never flying directly over a metropolitan area if a slight detour on a long trip will serve to avoid it. Additional caution in disposing of tools and cargo and in controlling the behavior of passengers is an even plainer step, and quite as impor-

tant. If we aim to preserve our popularity, the aviation industry must give the ground-bound populace consideration along with the airplane patron.

ONE NEEDED STATISTIC

WITH all the figures that appear in the next forty pages of this journal, there is one that is signally missing. With all the attention that has been given to the investigation of aircraft accidents and the analysis of their causes, there is one highly important study in that field that has never been undertaken.

Accidents have almost disappeared from commercial air transport lines, but in miscellaneous and private flying, they inevitably continue to occur in considerable numbers, and the press reports them along with the list of week-end automobile fatalities which are an unhappily standardized feature of the Monday morning papers. The investigation of accident causes has, on the whole, been taken more seriously in the air than upon the highway. Only in two or three states has there been collection of data on the nature and the origin of automobile accidents anywhere near as thorough as the study which the Department of Commerce undertakes for all mishaps for civil aircraft within the United States.

The resultant reports have been elaborately classified by a scheme on which the National Advisory Committee and the War, Navy, and Commerce Departments have collaborated. We know how many accidents are due to errors of judgment, how many to failures of the ignition system, and how many to the deficiencies of ground personnel. It is all exceedingly valuable, but it is necessarily complex.

What we seek now is a much simpler scheme of subdivision. We want to see accidents grouped in just two classes: (1) those which could have been avoided by the application of ordinary common discretion and common sense; and (2) those which could not have been so avoided.

In operating any vehicle a certain proportion of the accidents that occur can be charged to the driver's having done things that he knew were dangerous at the time he did them. He did them either because he was in a hurry and "guessed he could get away with it," or because he was just naturally reckless, or because he wanted a thrill, or to show off. Eliminating the drunken driver from consideration, the proportion of automobile accidents that fall into the category of the obviously avoidable is relatively small. Perhaps it includes one out of four, and the other three-fourths are the result of ineptitude or inexperience or mutual misunderstanding between two drivers. The proportion of airplane "accidents" that happen because somebody deliberately goes out asking for them is much larger.

The inexperienced driver and the inexperienced airplane pilot can never be eliminated. Experience has to be acquired by practice in operation. The individual of limited competence can never cease to be a factor. Some pilots will always be much less skilful than others, but at least we ought to be able to get rid of the gentleman who flouts the readings of common sense and whose moving force is sheer bravado. The accidents in which he is involved are, one and all, avoidable accidents.

Unfortunately there are no figures, such as the Department of Commerce may perhaps soon find it worth while to prepare, on the division of accidents along the line that we have suggested. It is, however, our distinct impression that the proportion of serious mishaps in non-transport flying that can be set to the credit of doing things that no sensible person ought to do is exceedingly large. We should not be at all surprised to find it as high as 75 per cent. Eliminate that very large proportion and the average safety record of private owners and small commercial operators would be very much better than it now is. Flying would stand out as already much safer than non-fliers are generally prepared to believe that it can be. In short, it seems to us that the lay public, and to some extent the aeronautical world as well, is misplacing the emphasis in discussing safety or hazard in non-transport use of aircraft of existing types. There is a popular presumption that to make such flying safer the pilots must be more skilful. We disagree. Skill is of course a factor, and increased skill is always desirable, but we believe that its effect on danger is relatively slight. What is most important is not the raising of the minimum level of skill among pilots, but the raising of the minimum level of good sense. It doesn't take any skill to know that doing vertical banks at a height of three hundred feet, or taking off straight towards buildings when a perfectly good open space is available a little to one side, is bad business. Even a man who has never been in an airplane before would recognize that. Yet there are pilots of undoubted technical proficiency who seem never to have attained an understanding of such simple facts, and they are contributing far more than their share to the list of minor and major crashes.

The accidental death rate among all licensed pilots in the United States is not far from 2 per cent per year. We believe that a separate analysis of a group of pilots comparatively inexpert, but selected for their presumed high average of native caution and intelligence (one might take, for example, all those between thirty and forty years of age who own their own business or hold important executive positions under a corporation) would show an average accident rate less than one-half the average for the entire body of license holders. We have some little knowledge with which to back up that speculation, but admittedly it is still a speculation. Let us, with the connivance of the Department of Commerce, get some definite evidence.

News of the Month

GOOD NEWS FROM THE INDUSTRY

AS the first quarter of the year draws toward a close, there are several indications of the fact that, like business in general, the aircraft industry is slowly emerging from the slump of last winter. Noteworthy business is being done outside the United States by American manufacturers. The Bellanca Aircraft Company of Canada, Ltd., is in receipt of an order placed by the Canadian government for six Bellanca planes, of the Pacemaker type, powered with a single Wright 300 radial to be used for aerial photographic work and aerial survey work in the Dominion. The planes are to be built by Canadian Vickers, Ltd., at a cost of $200,000. The engines will be built at the Maisoneuve plant of the Canadian Wright Company, Ltd.

The Fairchild Aircraft Company, Ltd., is now constructing ten Fairchild monoplanes, equipped with the Canadian Pratt & Whitney Wasp engine, ordered by the Canadian Department of National Defense. When these planes are delivered, the department will own a total of 38 aircraft of Fairchild design. Canadian labor is to be used in the construction of the planes, and the materials used are to be of Canadian origin.

The War Department recently approved contracts involving the expenditure of $1,190,397.05 for new aircraft and engines for the Army Air Corps. One contract for $366,495.65 was awarded to the Curtiss Aeroplane and Motor Company for 30 observation planes, powered with the Curtiss 435 hp. engine. Two other contracts totaling $855,574.55 were awarded the Wright Aeronautical Corporation for 118 engines.

The Navy is also to receive new equipment. Contracts totaling $1,420,006 have been awarded to four airplane and two engine manufacturers for 63 airplanes and 128 engines. The Douglas Company has received a $567,137 contract for 30 observation planes. The Pratt & Whitney Company has received two contracts totaling $641,883. One contract is for 52 Wasp engines and the other is for 60 Hornets. Consolidated Aircraft Corporation has received a contract for three fast transports of the Fleetster type and spare parts. Total value of the contract amounts to $79,040. The Stearman Aircraft Company was awarded a contract for four primary trainers and spare parts, at a cost of $26,756. The planes will be powered with the Wright J-6 165 hp. engines. Fairchild Corporation received a contract totaling $60,513 for photographic planes powered with the Pratt & Whitney wasps. The Fairchild contract is for six planes.

The Aircraft Control Corporation of Philadelphia, manufacturer of airplane instruments and a division of the Bendix Aircraft Aviation Corporation, has been awarded an Army Air Corps contract for 1100 airspeed indicators and 300 magnetic compasses.

Another Army contract of the month went to Stanavo Specification Board, Inc., for 1,629,000 gal. of aviation gasoline.

The Curtiss-Wright Corporation has made a general summary of progress during 1930. Sales of airplanes and engines totaled $18,000,000. In the export field there was a 120 per cent gain over 1929. The Flying Service carried 156 per cent more paying passengers in 1930 than the previous year. On Jan. 1, 1930, the Curtiss-Wright Company had a carry-over inventory of 594 planes, on Jan. 1, 1931, that had been reduced to 151 planes.

With all space sold out in the municipal hangar at Detroit City Airport, where the National Aircraft Show is to be held, the management is planning to erect a large tent adjoining one side of the building to accommodate additional exhibitors. It is planned to make this annex an integral part of the show by attaching one side of the tent to one side of the building and keeping the wide hangar doors on that side open for easy access between the two. Up to the middle of January, 26 airplane and 78 engine and accessory exhibitors had been allotted space.

The merger movement has registered another advance with the acquisition of the Pittsburgh Metal Airplane Company, lately a subsidiary of Pittsburgh Aviation Industries Corporation, by the General Aviation Corporation, subsidiary of General Motors and already in control of the Fokker Company. Herbert V. Thaden, general manager of the Pittsburgh company and designer of its product [described in AVIATION for January, 1931, p. 60] is expected to remain active under the new control. So is George R. Hann, president of P.A.I.C.

NEW DESIGN

THE Boeing Aircraft Company of Canada, Ltd., is now in production on a new type of all-metal flying boat, to be known as the Boeing "Totem." This plane, the result of careful study of Canadian operation requirements, is a four-passenger, high wing, cabin monoplane, powered with a 300 Wasp Junior.

One of the most interesting designs to be tested in the first weeks of the new year is the work of Grover Loening. It is a single-place, pusher-type monoplane flying boat powered with a 100 hp. Warner Scarab engine. The plane was especially designed for submarine co-operation and observation work, and by a novel method of attaching empanage, wing struts, and engine mounting struts it is possible to fold the whole plane up and store it in an 8-ft. tube carried on the forward deck of an under-water craft. The pilot sits well forward in the hull and according to reports has unusually good visibility.

Although the idea of equipping a submarine with a plane is not new, no design has thus far given enough promise of being practical in submarine service to be adopted for regular use by the Navy. The plane has a wingspread of 38 ft.; when fully equipped the weight of the plane will be about 1560 lb. The entire power-plant unit can be dropped down into the hull. The tail surfaces can be folded up and placed flat on the rear of the hull. The wings are detachable, not merely folding. Mr. Loening enrolled as one of the very small group of designers who act also as test pilots when he made the first test flight before Navy ob-

Calendar

March 25-27	Third National Conference, Airport Section, Aeronautical Chamber of Commerce, Mayo Hotel, Tulsa, Okla.
April 11-19	All-American Aircraft Exposition, City Airport Hangar, Detroit.
April 14-15	Second Annual National Aeronautical Education Conference, Aeronautical Chamber of Commerce, Hotel Statler, Detroit, Mich.
May 15-31	International Aero Exhibition, Stockholm.
August	(Tentative) National Air Tour.
Aug. 27-Sep. 7	(Tentative dates) National Air Races, Cleveland Municipal Airport.
Early Autumn	Schneider Trophy Contest, England.

servers. In view of the fact that in many cases cotter pins are used instead of nuts, rough-water tests are looked forward to with considerable interest.

INDUSTRIAL ASSOCIATIONS ELECT

AT the annual meeting of the stockholders of the Manufacturers Aircraft Association, Inc., Frank H. Russell was re-elected president; J. Don Alexander, vice-president; Walter C. Davis, secretary, and C. J. Bruckner was elected treasurer. S. S. Bradley will of course continue as assistant secretary, assistant treasurer and general manager.

The annual report read at the meeting gave every indication of notable progress by the Association since its last regular meeting. Briefly, the number of manufacturers now connected with the Association has practically doubled; the number of planes that have been reported and licensed through the Association now totals 25,346; the payments of royalties have been increased.

A suit involving alleged infringement of four Curtiss-owned airplane patents by the Nichols-Beazley Airplane Company of Marshall, Mo., was recently filed in the Kansas City, Mo., Federal Court. An injunction suit to prevent the Marshall company from further manufacture was filed by the Curtiss Assets Corporation of New York City. Answer has been filed by the Nicholas-Beazley Company.

At a recent meeting of the Aeronautical Chamber of Commerce of America, Charles L. Lawrance was elected president of the Chamber to succeed Frederick B. Rentschler, who served during 1929 and 1930. This is the second time that Mr. Lawrance has been elected president, as he served in that capacity in 1924 and 1925. Mr. Lawrence was elected by the board of governors, the members of which had been elected earlier in the day at the annual members' meeting of the Chamber. The membership of the board of governors for 1931 is as follows: F. G. Coburn, Aviation Corporation; G. B. Grosvenor, American Airways Inc.; R. B. C. Noorduyn, Bellanca Aircraft Corporation; P. G. Johnson, Boeing Air Transport; J. A. B. Smith, Curtiss Aeroplane & Motor Company; Edward F. Evans, Detroit Aircraft Corporation; Thomas B. Doe, Eastern Air Transport Inc.; J. M. Schoonmaker, Jr., Fokker Aircraft Corporation; Jerome C. Hunsaker, Goodyear-Zeppelin Corporation; George S. Wheat, Pratt & Whitney Aircraft Company; J. T. Trippe, Pan-American Airways, Inc.; E. L. Cord, Stinson Aircraft Corporation; Harris M. Hanshue, Transcontinental and Western Air, Inc.; C. J. Bruckner, Waco Aircraft Company; G. W. Vaughan, Wright Aeronautical Corporation; John R. Cautley, Bendix Brake Company; J. R. Fitzpatrick, Haskelite Corporation; Grover Loening, Grover Loening Company, Inc.; C. H. Colvin, Pioneer Instrument Company; E. E. Aldrin, Standard Oil Company of N. J.; Reed M. Chambers, U. S. Aviation Underwriters, Inc.; L. H. Merrill, American Gas Accumulator Company; G. S. Childs, Autogiro Company of America; R. B. Barnitz, Los Angeles Municipal Airport; Carl F. Egge, National Air Pilots' Association, and L. H. Brittin, Northwest Airways.

In addition to the Board of Directors, seven vice-presidents were chosen. William B. Mayo is secretary for 1931, J. C. Hunsaker treasurer, and Luther K. Bell was re-elected as general manager and assistant secretary.

According to the annual report for 1930, the Chamber practically held its own on membership. When the final board meeting of the year was held on Oct. 7, 1930, membership in the Chamber totaled 924, of which 393 were classified as companies and organizations connected with the industry. The other members are individuals.

According to the Aero Chamber's final survey for the year, there were 2,684 commercial and military planes produced in the United States during the year 1930, with an aggregate value of $21,469,763. Airplanes and engines together were valued at $38,548,679. In the commercial field alone, 1,937 planes were built and 2,324 were sold, the difference representing the disposal of carried-over stock.

Taking the aircraft engine units separately, there were 3,766 commercial and military power plants manufactured during 1930 for a total value of $17,078,916 as compared with 7,373 units valued at $26,495,830 in 1929. Like airplane sales, engine sales for 1930 exceeded production, but in this case by only about 2 per cent.

LEGISLATION AND THE COURTS

A BILL seeking the continuation of the New York State Aviation Commission has been recently introduced in the State Senate by Senator J. Griswold Webb, chairman of the commission, who wants to extend the limiting date for the final report to March 1, 1932, and obtain another appropriation of $40,000 to cover the commission's expenses. Governor Roosevelt is in favor of the extension.

An act which has been introduced in both the New York State Assembly and Senate and committed to the Committee on General Laws is one which amends the civil rights law in relation to damages to persons and property arising from the use of airports and aircraft. The act provides that the owner, proprietor or lessee of an airport or landing field shall not be liable to the owner, proprietor, operator, or passengers of an aircraft for injuries to persons or property unless such injuries be the result of negligence on the part of the above mentioned airport officials or their agents and employees.

Another important act introduced in the New York State Assembly and referred to the Committee on Public Safety would endow the Power Commission with the right to order the change of location of any electrical transmission lines, wire or poles within 1,000 ft. of any recognized airport, if it be shown that they constitute a hazard to the operating planes.

With the support of a large and distinguished advisory council of lawyers and laymen, the American Academy of Air Law has been founded in New York. Although an independent and self-controlling body, the Academy is being inaugurated by members of the Law Faculty of New York University, and especially by Dean F. H. Sommer and Professor Alison Reppy. Planning nation-wide scope for its work, it takes as its function the stimulation, co-ordination, and exchange of studies of the law of the air.

The Irving Air Chute Company announces that the United States Circuit Court of Appeals has reversed the findings of a lower court and has rendered a decision in favor of the plaintiffs in a suit by the Irving company and Floyd Smith Aerial Equipment Company against the Russell Parachute Company for infringement of patents taken out by Smith in 1918-19.

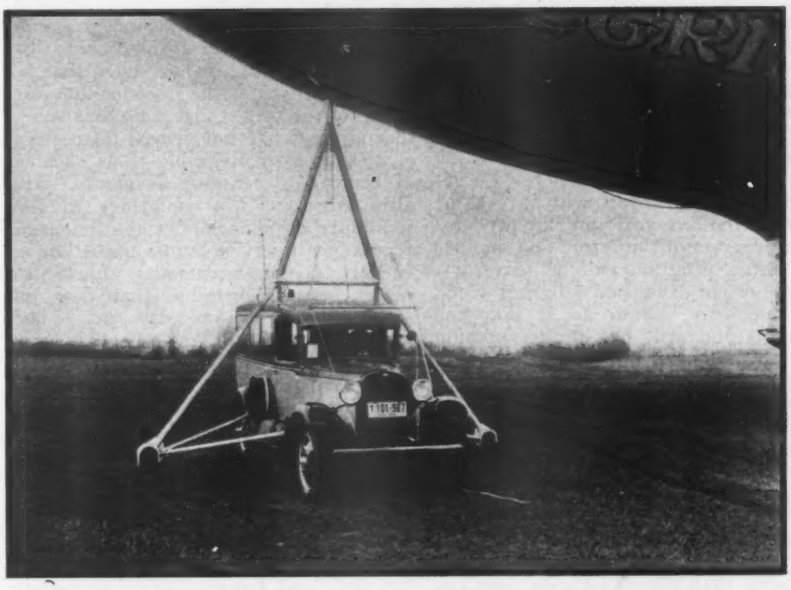
The road to receivership has been taken by the New Standard Aircraft Corporation of the State of New Jersey. Kenneth Jones, treasurer of the Hamilton Trust Company of Paterson, N. J., has been appointed receiver. It is believed that a reorganization will be attempted. An effort will be made, it is said, to raise $50,000, of which $11,000 will be used to pay wages due the company employees. After that the company will continue to operate under the direction of Mr. Jones.

The Court of Common Pleas of Lancaster County, Pa., has appointed Elmer L. Esbenshade as temporary receiver to take charge of the assets and business of the Lancaster Airways, Inc.

Purchase was recently made from receiver A. Harry Moore of the Crescent Aircraft Company, of Jersey City, N. J. The purchase was made by Clarence D. Chamberlin, former head of the company, and the price was reported as $7,500. This concern went into bankruptcy several months ago. According to Mr. Chamberlin he intends to carry on the business, and manufacture planes. When the bankruptcy petition was filed, the assets of the concern were stated as being two completed airplanes, two partially completed units and some equipment. The planes were designed by Chamberlin himself and are of the high wing cabin monoplane type.

PERSONNEL MOVEMENTS

SEVERAL personnel changes have been made in the industry during the past few weeks. Capt. Frank M.



Goodyear-Zeppelin develops its own movable mooring mast. This device, known as the Typeeportable mast, has been successful in handling the company's blimps. The car is large enough to transport the ground crew from place to place.

Hawks is now aeronautical adviser for the Texas Oil Company. J. D. Jernigin is to fill the position of aviation manager vacated by Captain Hawks. Peter J. Clausen, who served as mechanic for Captain Hawks, has been appointed chief maintenance foreman and will be placed on special work.

At a recent meeting of the board of directors of the Hamilton Standard Propeller Corporation, of Pennsylvania, Raycroft Walsh was elected president of the corporation to succeed E. E. Wilson, who resigned the presidency to devote more activity to the Sikorsky Aviation Corporation of which he is president.

Captain Rufus F. Zogbaum, at present commanding officer of the U. S. S. Langley, second line aircraft carrier, is to receive orders as commandant of the Naval Air Station at Pensacola, Fla., as relief for Read Admiral Albert W. Marshall, who has been assigned to a non-aeronautical command.

Charles H. Day, well known for his airplane design contributions to the industry, has resigned as president and chief engineer of the new Standard Aircraft Corporation, of Paterson, N. J. Mr. Day plans shortly to open an aeronautical engineering consulting service in New York City.

Edward B. Heath, pioneer light plane designer and pilot, was killed on February 1 by a structural failure of an experimental machine which he was testing. Mr. Heath had been active in aviation for nearly twenty years, had always specialized on planes of exceedingly small span and low power, and had always flown them himself. His most spectacular product was the "Baby Bullet," the tiny racing machine which, in various forms, had won victories and startled the crowds at the National Air Race meets of the last three years. He was a firm believer in making aviation simpler and cheaper, and opposed to everything that interfered with the attainment of those ends.

L. W. Greve, president of the National Air Races, Inc., has announced his appointments of Clifford Gildersleeve as executive vice-president and Clifford W. Henderson as managing director of the annual National Races, which are to be given in Cleveland for the next ten years.

The Stinson Aircraft Company has appointed Lee H. Smith to act as its district sales manager for the southeastern part of the country. The company has also appointed John C. Kelley, Jr., as traveling sales manager with the whole country under his supervision.

Wing Comdr. Charles Kingford Smith's world-famous plane "Southern Cross" has been shipped to Sydney, Australia, where it will be placed in the National Aviation Museum.

LAW ENFORCEMENT AT WASHINGTON

ACCORDING to Gilbert G. Budwig, director of Air Regulations, the number of wayward pilots was fewer during the last quarter of 1930 than during any of the three other quarters. The total violations of the regulations for this period represented a decrease of eleven over the third quarter of 1930, while the total number of persons assessed decreased 46. Thirty-six of the individuals who ran afoul of the regulations during the last quarter were assessed for a total of $465 in fines. The other penalties were in the form of 41 reprimands, 47 suspensions, seven revocations and three denials of licenses. In 104 cases evidence was produced which testified dismissal of the case. A study of Director Budwig's report shows that the low flying pilot is still very much in evidence, as is also the pilot whose great desire is to turn the plane inside out. There were 55 violations of the low flying provisions and 48 of the acrobatic clauses of the regulations. Twenty-seven unlicensed pilots tried to fly licensed planes, much to their sorrow when they were caught, and one individual was punished for flying without navigation lights.

LAW ENFORCEMENT IN BOSTON

OF THE many statistics presented in a report for 1929 and 1930, recently issued by the Aviation Section of the Massachusetts Registry of Motor Vehicles, perhaps the most interesting are those which deal with pilot and plane examinations, violations of the state air laws, and accidents. Pilots permits issued in 1929 total 173, whereas in 1930, that number was increased to 338, and divided among transports, limited commercial, private, industrial, and glider permits. The greatest number of permits granted under any one classification was 146 for private permits. Airplane and glider permits issued in 1929 total 135 and that number was increased to 231 in 1930.

In 1929, there were 41 suspensions of licenses in the State of Massachusetts. In 1930 that number was increased by twelve. The major cause for suspension was dangerous operation. There was a slightly reduced number of court prosecutions in 1930 as compared with 1929, and fines paid during 1930 were only one-quarter of the fines paid in the year before.

Of the fifteen-odd thousand individuals who held pilot licenses in this country, beginning with the new year, 385 were women. A total of 35 of them held transport licenses, 50 of them held limited commercial licenses, and 297 of them are private pilots. It is also interesting to note that five women hold mechanic's licenses.

ENGINE AND PLANE RESEARCHES

OF particular interest to those individuals who are annoyed by the racket caused by airplane engines, is the announcement by the Aeronautics Branch that a study of engine mufflers as a means of reducing airplane engine exhaust noises has been undertaken by the Branch under the direction of Harry H. Lee, director of Aeronautical Development. The study is to be conducted by the Branch through its Research Division at the Bureau of Standards. The active co-operation of manufacturers of engine mufflers and of other interested persons who wish to submit mufflers for test, has been invited. For the investigation a 180-hp.

1,800 r.p.m. model E Hispano-Suiza engine has been secured.

Although investigation has been underway for some time, Dr. George W. Lewis, director of Aeronautic Research for the N.A.C.A., recently made the first public announcement to the effect that the N.A.C.A. is conducting experiments to determine the exact effect that rough-air flying has upon airplane structures. Accelerometers to record the total air load on the plane at every instant, have been installed on a number of planes in regular transport service. There exists a great deal of knowledge of the loads on the structure resulting from all sorts of maneuvers, but very little is known about the structural effects of straight flying under severe conditions. Load factors now used in designing transport machines have very little real experimental evidence to support them.

Successful tests have been conducted on the Lockheed retractable landing gear, and this item of equipment is now optional on planes of the "Sirius" low-wing type. The retractable landing gear is announced to add from 15 to 20 m.p.h. to the top speed performance of the plane.

THE AIR CORPS GETS ITS MONEY

THE usual drawn-out congressional discussion and argument has come to a close and the War Department appropriation bill has been passed by the Senate. The Army Air Corps has been appropriated $31,522,295 for expenditure during the fiscal year ending June 30, 1932. The House had originally set the appropriation at $31,679,635 but the Senate established the lower figure and the House consented to the Senate figures. The appropriation for the previous fiscal year amounted to $35,823,473. An amount not exceeding $2,310,377, an increase of $54,447 over the 1931 appropriation may be expended for experimental and research work with airplanes or lighter than air craft and their equipment. This figure was originally set by the House at $2,510,377. The $200,000 difference represented the sum appropriated by the House to be expended for investigation of a metal clad airship. However, when the bill reached the Senate this amount was stricken off after the Senate committee had listened to a plea by lighter than air manufacturers that the additional $200,000 be appropriated. The House yielded to the Senate, and the $200,000 stayed out. The sum of $300,000 is allowed for the production of lighter than air equipment and represents an increase of $221,550 over the 1931 funds allowed.

The sum of $15,296,231 is for the production or purchase of new airplanes and their equipment, spare parts and accessories whereas in the 1931 budget $17,573,723 was appropriated. With regard to the fifteen-odd million appropriated for the purchase of new planes, Maj. Gen. James E. Fechet, chief of the Army Air Corps, on originally appearing before a sub-committee of the House committee on Appropriations, called attention to the fact that the budget estimate submitted to Congress included a decrease of $2,277,492 in the item of new planes. General Fechet stated that adjustments will have to be made in the five-year aircraft procurement program of the Army and another purchasing program will be necessary, as the present expansion program which has one year yet to go is not well balanced and will not in his opinion give the United States a properly equipped air corps. Army Air Corps plane purchases for the last year of the five-year program, will include 126 pursuit planes, 27 bombardment, 89 standard observation, three amphibion observation, 120 primary training, fifteen tri-engined cargo, sixteen single-engined cargo planes.

The Navy's appropriation bill is less advanced than the Army's, having just reached the point of being reported out of committee to the House of Representatives. In general, the bill follows the recommendations contained in the Budget, and carries the right to spend $30,550,000 on naval aviation, not including improvements and new buildings at air stations. Only $11,550,000 is provided for new planes and engines. The committee allowed funds for starting the second of the new Goodyear-Zeppelin airships, the fate of which has been the subject of some doubt.

A startling element in the committee report on the Navy bill was the inclusion of a recommendation that future increases in aviation personnel should be cared for by using larger numbers of Reserve pilots on one- or two-year terms of active duty, giving up the practice of depending almost entirely on Annapolis graduates. To give point to its suggestion, the committee inserted in the bill a stipulation that the Navy Department should make no further increases in the number of officers above the rank of Lieutenant-Commander assigned to aviation duty.

AIRSHIPS IN COMMERCE BEFORE CONGRESS

THE Parker-McNary merchant airship bill which provides for international transportation of mail, goods and passengers by lighter than air craft, has recently been under discussion before the Senate Commerce Committee. The bill was introduced simultaneously in both the House and the Senate. The bill has attracted considerable attention throughout the industry in view of the fact that it provides for the use of lighter than air craft instead of heavier than air craft. Until recently Post Office Department officials have made no statements regarding their preference for the type of craft to be used. However, last month, Postmaster General Brown, in an Associated Press statement, declared himself for the first time on whether airships or airplanes are better suited to trans-oceanic air mail service. Mr. Brown stated that he was in favor of the heavier-than-air craft, for the reason that it was his belief that airships had not proven themselves as speedy, as manageable or as capable of keeping to schedule as planes. He also expressed his confidence in the feasibility of immediate establishment of regular mail service across the Atlantic. In part Mr. Brown stated: "There has never been a dirigible that flew on schedule day in and day out. The Akron, (the giant Navy dirigible now being completed, at the Goodyear Zeppelin Plant in Akron, Ohio) has many novel features which may improve matters and which we will all find interesting to watch. But my suggestion is that the lighter-than-air carrier prove its worth as did the airplane. Put a dirigible on the southern trans-continental route from Atlanta to El Paso, say, that is easy and even, no mountains to climb, well lighted, plenty of landing fields. They may need a few mooring masts, but that probably can be arranged. Then when dirigibles can fly that route on schedule, it is time to talk about flying the ocean."

THE ARMY AND NAVY SIGN A TREATY

FOR many years the Army and Navy have been at grips as to which service should control the coast defenses. Some time ago, President Hoover insisted that an investigation be made of this matter and a definite agreement reached. After much argumentation, exchange of letters and conferences, the War and Navy Departments have agreed to let the Army have charge of coast defenses, although the Navy will continue its stations at Coco Solo, Canal Zone, and Pearl Harbor, Hawaii. The agreement carries a provision that the Army air forces shall be land based and that the naval air forces shall be based on the fleet. Under this agreement, the fleet is assured of absolute freedom of action without any responsibility for coast defense. Coco Solo and Pearl Harbor were the two concrete examples of the unsettled situation. It was the Navy's contention that the planes it maintained at the field, were merely for keeping open communications with the fleet. However, the Army Air Corps which has adjoining field maintained that the presence of Navy planes placed the Navy in a position of participating in coast defense. Although the Navy will replace its planes at both Coco Solo and Pearl Harbor, as the equipment on hand becomes obsolete, they will function only as reconnoissance planes for the fleet, and in the event of war, they will leave the defense of the land to the Army Air Corps and will proceed to their tenders at sea.

With the idea of conducting experiments with the Autogiro as a possible observation craft for Navy purposes, the Navy Department recently pur-

chased one from the Autogiro Company of America, formerly the Pitcairn Cierva Autogiro Company. The Navy's classification of the craft is XOP-1. In addition to the experiments to be made with the plane in landing in small spaces, it is the intention of the Bureau of Aeronautics to extend the experiments to landings aboard the U. S. S. Langley, which will base on the Atlantic Coast following fleet maneuvers at Panama.

AIRLINE DEVELOPMENT

CONTINUING its refinement of the federal airways system, the Aeronautics Branch of the Department of Commerce recently contracted for $90,000 worth of equipment and work on new airway projects, principally along the El Paso-Fort Worth and San Diego-Los Angeles airways.

The Department recently ordered from the Westinghouse Electric & Manufacturing Company a combined radio-telephone and visual type radio range transmitting installation. This new instrument, devised by the Aeronautics Branch, enables simultaneous reception on one radio frequency channel of both radio guidance signals and weather and other information by voice, without having to carry two receivers. It will be set up for service tests. The only change necessary in the radio equipment on the aircraft to use this new transmitter will be the addition of a filter weighing about 1 lb. This directs the voice signals through the headphones and the radio range signals through the vibrating reeds of the indicator on the instrument board.

Because of the limited number of frequencies available for the use of radio range stations, the Department of Commerce proposes to synchronize transmission from two neighboring stations by means of clocks controlling the automatic keying of the transmitter. Thus one station will be timed to operate one minute "on" and then will be "off" while the other transmitter is "on" for one minute.

The sensitivity of the visual type reed indicator on the visual radio range beacon has been improved about 100 per cent through refinements in design of the permanent magnet, particularly the use of Allegheny Metal, a nickel-steel alloy, for the reed material. Excellent shielding has been procured by constructing the indicator mounting case of magnetic material.

The latest addition to the post office department's air mail network is the daily service between Minneapolis and St. Paul and Winnipeg. It was opened on Feb. 3, the inauguration scheduled for the day before having been postponed because of fog.

This new international service is operated jointly under Canadian and American auspices. Northwest Airways planes carry the mail from Chicago and Minneapolis as far north as Pembina, N. D., where it is taken over by Western Canada Airways machines for the rest of the trip to Winnipeg. On the inaugural flight, Northwest used a Hornet-powered Hamilton metal plane, western Canada a Fokker. North-bound planes transfer from wheels to skis at a few miles north of Grand Forks, N. D. This service is an extension of Contract Air Mail Route No. 9 under a plan approved last summer. Because of its connections through Western Canada Airways to Aklavik, in the Yukon, it figured in recent consideration of an eventual air mail service into Asia.

POSTMASTER GENERAL UPHELD

THE air mail contract awarded to Transcontinental & Western Air last fall for the central route between New York and Los Angeles was protested by United Avigation of Pittsburgh on the ground that its bid had been lower and that there was no legal warrant for the requirements of specialized experience. Postmaster General Brown's action has been upheld by Comptroller General McCarl.

The explanations advanced were to the effect that: (1) United Avigation had not actually acquired the stock of its alleged subsidiaries, (2) The company must have had "only a bare, naked, corporate existence"; and (3) it had been so vague and indefinite in statements regarding type of planes to be used that the government concluded the bidder could not equip itself for service within the period of 30 days prescribed by the contract.

United Avigation bid 64 per cent of the maximum rate allowed, while Transcontinental & Western Air bid 97.5 per cent of the maximum. The latter began operations Oct. 25, 1930.

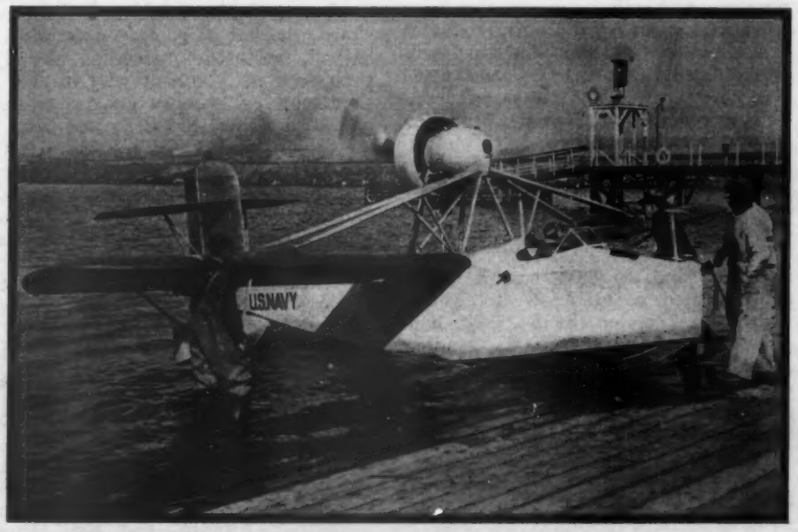
National Air Transport, on Feb. 1, extended its Chicago-Kansas City passenger service south to Forth Worth and Dallas by way of Tulsa and Oklahoma City. This is in response to the Post Office Department's stipulations, as are other recent passenger service installations. There will be one service a day, using Ford transports with the new wing mail compartments.

National Air Transport, also on Feb. 1, established lower passenger rates on many runs. The air fare between New York and Chicago remains the same at $59.50, but the air-rail fare between the two cities has been reduced from $55.78 to $49.53. The flight between Chicago and Kansas City now costs $30.66 instead of 34.85; that between Chicago and Cleveland $19.75 instead of $26.

Pan American Airways instituted a general reduction of passenger fares on all its lines on Feb. 12. The cuts range from 8 to 42 per cent.

American Airways announced in January that its planes had flown 6,961,208 mi. during 1930, and had carried 1,230,439 lb. of mail, and 60,074 passengers. These represent increases over the 1929 figures of 21.2, 14.8 and 23.7 per cent, respectively. Ludington Line's every-hour-on-the-hour service carried 4,017 passengers during January, an average of 130 per day.

Transcontinental & Western Air has begun intensive cultivation of express traffic. It is offering a 36-hr. coast-to-coast service, at the rate of $1.50 per lb., which is graduated downward to $1 per lb. for shipments weighing in excess of 100 lb. The rates to intermediate points are constructed on a zone basis; zone 1 extends west to St. Louis; zone 2 to Albuquerque, N. M., and zone 3 to the Pacific Coast. The service will be limited to packages weighing 200 lb. or less. Transporta-



The Navy's new Loening design. This machine was developed for installation on submarine and, following demonstration tests at Glen H. Curtiss Airport early in February, was accepted by the Navy for further trials.

tion is by the regular transcontinental mail and passenger service which has been in operation for several months.

This same company has completed its own radio network of twenty stations along its transcontinental airway; there is a station in each one of the cities served by the line. Radio-code is used for inter-station communication and radio-phone for communication between planes and ground.

Each station is equipped with a crystal control type transmitter of 500 watts output with five tubes, including the crystal oscillator, frequency doublers and power amplifier. The power is supplied by a six-phase mercury vapor rectifier. The transmitters have a normal range of 400 mi. and operate on high frequencies (short wave) ranging between 1,500 and 12,000 kc.

Comment was made recently by the Weather Bureau on meteorological conditions along the proposed Bermuda-Azores trans-Atlantic airway. Though weather on such a route would be quite normal during three-quarters of the year, it would be extremely dangerous during the hurricane season (the autumn). This is because of our lack of knowledge of hurricane characteristics in that area and absence of facilities to detect and trace disturbances. The Bureau believes, however, that this southern route is preferable to the great circle route in the North Atlantic and suggests that at least six station ships be placed on, and south of, the proposed airway for a period of intensive observation of hurricane phenomena.

AIRPORT NOTES

WORK has been started on the first unit of a 1,300-acre airport project in Norwood, Mass., 12 mi. southwest of Boston. This field will have four 2,500x500-ft. gravel and oil runways and will be ready for flying operations about April 1. An 80x100-ft. hangar with 80-ft. shop and an administration building are to be constructed.

A new American Airways passenger waiting room at the Newark Municipal Airport was opened Feb. 3. Users are Ludington Line, Eastern Air Transport, Transcontinental & Western Air, Pittsburgh Airways, and American Airways.

Ground work on Oklahoma City's 640-acre municipal airport is well underway and the field is scheduled to be completed about April 1. Among expenditures under the $425,000 bond issue are: Land, $162,000; grading, $65,000; drainage, $22,000; water and sanitary sewer system, $19,000; base gravel for runways, $44,000; lighting, $15,000; terminal and administration buildings, $75,000.

Northwest Airways has established at Pembina, N. D., a 180-acre international airport in connection with its Minneapolis-Winnipeg mail and passenger service.

Congress has approved the bill authorizing the Army to lease Governors Island in Boston Harbor to the City of Boston for incorporation in the municipal airport development. This island, about 1 mi. east of the airport, is connected with it by flats which are exposed at low tide. This area is being filled in and with the island will make available several hundred additional acres.

Eighteen Sperry-AGA floodlights, containing two 500-mm. dioptric lenses each, are being installed at the Naval Air Station, Pensacola.

Airport fires continue to take their toll. The most serious recently was at Roosevelt Field, L. I., where three of the old wartime wooden hangars were destroyed with some of their contents, and another hangar was damaged. Loss was estimated at about $200,000. Six planes and a glider at the Kenosha (Wis.) Airport were destroyed by fire on Jan. 20. Loss was estimated at $45,000.

A number of personnel changes have been announced among the lines and ports. H. A. Burgess has been appointed general traffic manager of Western Air Express and Midcontinent Air Express, and Charles F. McManus as his assistant. Operating control of Continental Airlines and the Embry-Riddle company, both American Airways units, have been combined under the management of John Riddle, vice-president and general manager of the latter concern. K. S. Lindsay has been made manager of the Valley Stream, L. I., Curtiss-Wright Airport, replacing Walter A. Avery, who continues with the company in another capacity. Harold A. Elliott is now vice-president and general manager of Eastern Air Transport.

ANNUAL AIRPORT CONFERENCE

SEVERAL hundred airport managers, designers and associates will migrate to Tulsa, Okla., next month for the Third Annual Airport Conference to be held under the auspices of the Airport Section, Aeronautical Chamber of Commerce. The open general sessions will be held on the 25th and 26th of the month, and closed sessions for airport managers and airport equipment manufacturers will be held on the morning of the 27th. The conference will close at luncheon on that day. Speakers, chairmen and discussion leaders include expert representatives of the Department of Commerce, and municipal and commercial airports.

There are now four airports rated under the provisions of the Airport Section, Aeronautics Branch. The third and fourth to receive this recognition are the Rickenbacker Airport at Sioux City, Ia., and the Municipal Airport at Brownsville, Tex. The first and second were the Pontiac (Mich.) Municipal Airport, and the Denver (Colo.) Municipal Airport.

The Rickenbacker Airport is given the A-1-A rating. The dash under the A qualifies that designation for excellence of general equipment only because the airport had insufficient roof space to carry the full name of the airport and the name of the city it serves. The Brownsville airport received the A-1-A rating without qualification.

AIRPORT TRAFFIC

A NUMBER of airports have reported interesting traffic figures for 1930. The Los Angeles Municipal Airport had a total of 72,141 landings, and 3,901 visiting planes. At Detroit City Airport, 12,601 arrivals and 12,797 departures, made by 1,978 different airplanes, and sale of 66,548 gal. of gasoline and 206 gal. of Diesel oil.

At the Kansas City (Mo.) Municipal Airport, 33,125 landings and takeoffs. Passengers arriving or departing in transport planes totalled 32,636, and the port cleared 1,448 transient planes and sold 545,667 gal. of gasoline.

Century Airlines, Inc., which recently announced plans for an hourly service between Chicago, Detroit, Cleveland and St. Louis, has been granted a letter of authority from the Aeronautics Branch, Department of Commerce. The tentative plans provide for three trips daily each way between Chicago and St. Louis; five trips daily each way between Chicago and Toledo, and six trips daily each way between Detroit and Cleveland through Toledo, with connections with the Chicago plane. Frequency will be increased later. To carry out this program the company expects to operate nine planes. Six will be in actual operation at any one time, three in reserve. Two planes will be in service on each of the three lines.

Pan American Airways inaugurated weekly mail and passenger service on Feb. 11 between Maracaibo, Venezuela, and Port of Spain, Trinidad. This completes Pan American's circle around the Caribbean Sea. The complete circuit may be made by plane in six days.

The Post Office Department reports 583,378 domestic registered articles sent by air mail during the last fiscal year, an increase of 28.58 per cent over the previous year.

FOREIGN AIRLINES

INAUGURATION by Imperial Airways of the first (northernmost) section of the Cairo-Capetown airway has been postponed from the latter part of February to March 5. Other sections of the route will be opened as rapidly as physical conditions permit, and it is anticipated that the complete route will be in operation by the middle of the summer. Prospects of extending the London-Karachi mail and passenger service across India and eventually to Australia become much brighter with the recent appointment of Col. Francis

General Balbo at the end of the long cruise. The Italian formation flight leader aboard his flagship in Rio de Janeiro harbor.

C. Shelmerdine, an expert in the intricacies of Indian politics as they affect aviation, to the post of Director of Civil Aviation in the British Air Ministry.

Aeropostale has extended its South American air mail service north from Natal to include Maracaibo, Caracas, and Trinidad with a weekly service. This provides direct connection between these points and the European points served by this company.

RECENT FLIGHTS

TWO record-making flights have been reported from Europe. The Savoia-Marchetti company of Italy claims a new altitude record for seaplanes with a useful load of 2,000 kg. On Jan. 31 the company's chief test pilot flew a model S-71, a twin-hulled monoplane similar to the well-known S-55, to an indicated height of 21,396 ft. The previous holder of this record was Capt. Boris Sergievsky, who used a Sikorsky S-38 to reach an altitude of 19,928 ft.

Marcel Lalouette and Jean de Permangle flew a Farman low wing monoplane, model F. 231, equipped with a 100 hp. Renault, to a new stright-line distance record in the first category for light planes—two seaters weighing less than 881 lb. empty. The distance flown was 1,687 mi., the time 22 hr., the route from Istres, France, to French West Africa.

Another notable flight of the winter was the return of the French pilots, Goulette and Lalouette, from Saigon to France in five days and 16 hr. total elapsed time, bringing with them as passenger the governor of the colony. The 7,126-mi. journey eastward to Saigon had been negotiated by them in five days, 3 hr., 50 min.

A plan to make the King's Cup Race, England's premier air derby, a purely amateur affair has been approved by the Royal Aero Club and King George. Not even an employee or director of an aircraft firm is to be eligible to enter or to compete as pilot. Royal Air Force pilots, however, will be allowed to compete. Furthermore, any person entering a plane for the race must have been the owner of it for at least three months prior to the entry. This is a bold move, but the plan is meeting considerable opposition because of ambiguity of the definition of the amateur status and because of widespread objection to the fundamental principle of barring the professional pilot.

The recent purchase of 45 Fairey Firefly single-seater fighters from England by the Belgian government created an industrial sensation. It was followed by another Belgian order for a number of Fairey Fox day bombers, powered with Rolls-Royce "F" engines of 500 hp. The aggregate value of the two Belgian orders was in excess of $1,500,000. The Fairey Aviation Company, their recipient, reported for the year ending Sept. 30, 1930, a profit of $849,000.

There is in process in England an inquiry, by a joint committee of the British Air Ministry and the aircraft industry, into the complaint of certain constructors that the British Aircraft industry is seriously handicapped in foreign markets by the rigidity of the British airworthiness regulations, making it impossible to meet foreign competition on price and performance.

The Italian trans-Atlantic formation flight, using Savoia-Marchetti S-55 flying boats, reached its destination—Rio de Janeiro—on Jan. 14. A week later it became known that the Italian government planned to supplement this exploit with a formation flight from Italy to New York in 1932. Technical and operating problems are being studied by Italian experts. It will be recalled that when the recent flight was first planned, it was to have been made to this country rather than to South America. It has been learned that Stanavo gasoline was used on the trans-Atlantic venture, the fuel consisting of a mixture of 75 per cent Stanavo and 25 per cent benzol.

The Dornier Do.X continues to encounter misfortune in its attempt to fly the Atlantic. Following completion of repairs necessitated by the burning of one wing at Lisbon, the machine was flown to Las Palmas, Canary Islands, but in an attempt to take off from Las Palmas sufficient damage was done to the hull by rough water to necessitate a two weeks' delay for further repairs. Vacuum Oil Company reports the following information from Lieut. Clarence H. Schildhauer, co-pilot: "Do.X suffered damage to secondary strength members in an attempt to take off for Praia [Cape Verde Islands]. . . . Main strength members between boat and wings undamaged. . . . Weight 61 tons at take-off, 20-mi. wind. . . . Sea from side. . . . Do.X clear of water. . . . Wave struck side and force bent members. Seaworthiness comparable to 150-ft. yacht."

SCHNEIDER DEVELOPMENTS

WITHOUT government assistance the British aircraft industry recently declared participation in the 1932 Schneider Trophy Contest impossible, and criticism of the government's aloofness mounted to a high pitch. This was accentuated when Lady Houston announced her willingness to personally guarantee $500,000 for a British entry. Finally, as a result of pressure from all sides on the various departments of the government, it was announced that the government had changed its mind and would participlate to a limited degree, lending the machines and permitting Air Force pilots to fly, on condition that all extra expenses should be privately raised.

Active preparations for the British entry are now being made by the Air Ministry. Lady Houston, who is guaranteeing the expenses of the British entry, has requested the abandonment of any public appeal for funds.

The two Supermarine S.6 seaplanes which took part in the 1929 race, and which have since been flown by the High-Speed Flight at Felixstowe, have been delivered to the Supermarine Works at Southampton for overhaul and modification. While that work proceeds the Gloster VI. seaplanes, which also were built for the last race and were reconditioned by the constructors about two months ago, are at Felixstowe, and are available for early practice flights by pilots from whom the racing team will ultimately be chosen. This preliminary work will be done under the supervision of Squadron-Leader A. H. Orlebar, who was in charge of training for the race in 1929 and who may possibly be chosen for that duty again this year.

Two prominent European aviation leaders died recently. Air Commodore Charles Rumney Samson, retired, one of the first four British naval officers to be trained as a pilot, died on February 5. Up to within the last fortnight of his life, he had been active in planning for the British defense of the Schneider Trophy. Capt. Einar Paal Lundborg, the rescurer of General Nobile in 1928, was killed in a crash in Stockholm Jan. 27 while testing a new Swedish pursuit plane.

PRODUCTION AND LICENSING

THE report on commercial aircraft production from the Chamber of Commerce, printed at the bottom of this page, at first sight shows surprisingly little variation in percentage distribution of the various types over the past two years. Superficial indications are, however, somewhat misleading, as the needed production in some groups was much reduced by the carry-over from 1929. If the report of sales be examined, rather than that of production, a different story is told. An estimate based on sales, in fact, shows a steady increase of from 24 per cent in 1928 to 26 per cent in 1929 and 32 per cent in 1930 for the cabin monoplane. The open-cockpit biplane, conversely, shows a drop in proportion of total sales from around 64 per cent in 1928 to 58 in 1929 and 52 in 1930. Prior to 1930 these figures have to be approximations, as no detailed reports on sales were being made until a year ago.

There has been a substantial drop in the proportion of multi-engined transports, due in part to the influence of 1929 and to the overstocking of many of the transport lines at the end of 1929. The most surprising change, however, is the sharp drop in proportion of amphibions. That again seems to be somewhat misleading, for judging from the comparison of the Department of Commerce and Chamber of Commerce reports in the second column on the opposite page, a number of amphibions must have escaped being reported to the Chamber.

Average values of the machines produced in 1930 were much as in 1929 within each class, except the flying boats and amphibions. A sharp rise in the former figure and a sharp drop in the latter were accounted for on the one hand by the first appearance of the large passenger-carrying flying boat as an important factor in American air transport, on the other by the production of several small amphibions, ranging up to five-passenger capacity

Commercial Engine Production

	1929			1930		
Horsepower	Number	Value	Average Unit Value	Number	Value	Average Unit Value
0– 75	479	$367,950	$768	215	$158,213	$737
76–125	1,309	2,013,750	1,538	678	1,277,884	1,884
126–175	1,208	3,158,000	2,615	68	165,248	2,430
176–225	565	1,638,500	2,900	280	604,600	2,159
226–300	552	1,990,000	3,605	260	1,094,895	4,211
301 and up	1,404	8,727,100	6,216	424	2,954,653	6,968
Total Commercial	5,517	17,895,300	3,244	1,925	6,255,493	3,250
Military	1,861	8,600,530	4,621	1,841	10,823,423	5,879
Total with military	7,378	$26,495,830	$3,591	3,766	$17,078,916	$4,535

Commercial Aircraft Production

	1928				1929				1930			
	Number of Planes	Per Cent of Total Comm. Production	Total Value	Average Value	Number of Planes	Per Cent of Total Comm. Production	Total Value	Average Value	Number of Planes	Per Cent of Total Comm. Production	Total Value	Average Value
Open cockpit monoplanes	171	4.8	.....	.....	320	6.0	$871,890	$2,724	250	12.9	$731,990	$2,928
Cabin monoplanes	850	24.0	.....	.....	1,562	29.2	10,557,635	6,759	505	26.1	3,417,543	6,767
Multi-engined transports	58	1.6	.....	.....	178	3.3	6,122,742	34,397	38	1.9	1,389,984	36,578
Total monoplanes	1,079	30.4	$8,738,683	$8,098	2,060	38.5	$17,552,267	$8,569	793	40.9	$5,539,517	$6,985
Open cockpit biplanes	2,348	66.3	.....	.....	3,071	57.3	10,415,599	3,391	1,083	55.9	3,166,310	2,924
Cabin biplanes	69	2.0	.....	.....	47	0.9	598,040	12,724	20	1.0	285,880	14,294
Multi-engined transports	5	0.1	.....	.....	8	0.1	505,000	63,125	7	0.4	505,581	72,226
Total biplanes	2,422	68.4	$7,541,615	$3,113	3,126	58.3	$11,518,639	$3,684	1,110	57.3	$3,957,771	$3,566
Total open cockpit	2,519	71.1	.....	.....	3,391	63.3	11,287,489	3,328	1,333	68.8	3,898,300	2,924
Total cabin	919	26.0	.....	.....	1,609	30.0	11,155,675	6,933	525	27.1	3,703,423	7,055
Total multi-engined transport	63	1.8	.....	.....	186	3.5	6,627,742	35,633	45	2.3	1,895,565	42,124
Seaplanes and flying boats	11	0.3	.....	.....	32	0.6	834,950	26,092	17	0.9	954,386	56,140
Amphibions	30	0.8	.....	.....	139	2.6	3,718,900	26,754	17	0.9	294,369	17,316
Total	41	1.2	$914,000	$22,292	171	3.2	$4,553,850	$26,630	34	1.8	$1,248,755	$36,728
Total commercial	3,542	100.0	$17,194,298	$4,854	5,357	100.0	$33,624,756	$6,276	1,937	100.0	$10,746,043	$5,548
Military	1,219	.....	.....	.....	677	.....	10,832,544	16,001	747	.....	10,723,720	14,356
Grand total	4,761	.....	.....	.....	6,034	.....	$44,457,300	$7,367	2,684	.....	$21,469,763	$7,999

and at prices well below those previously established. If average retail prices on machines sold, rather than production values, had been taken as the criterion, most of the averages would have shown a sharp drop from the previous year. The carry-over was largest in the planes of smallest value, and many of them were sold at prices still further reduced in order to clear the way for new production.

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AGAIN as in 1929, the reported production of airplane engines is almost equal to the production of aircraft. Allowing for the number of engines that went into planes built by individuals or small manufacturers not reporting to the Chamber, and allowing for the effect of multi-engined machines on the total consumption, there would appear to be a deficiency of about 10 per cent in the number of engines produced as compared with the number consumed in aircraft. While a small part of that difference may be accounted for by engines in stock at the end of 1929, the major portion represents the use of the OX-5 and other war time power plants. The deficiency of engine production below plane production is less than in any previous year.

The class of engines from 126 to 175 hp. suffered the heaviest relative decrease during the year, dropping from 22 per cent to 4 per cent in the total output. The relative share of the engines of very high power (above 300 hp.) also decreased sharply. All other classes remain in about the same relative standing as before.

There have been no decisive changes in average unit values of engines produced, but on the whole the tendency has been to a rise in price per unit of power output. The general average of prices increased during the year by around 10 per cent, although in some classes there was a drop.

The aggregate value of the commercial engines produced was 30 per cent lower than in 1928, and about 65 per cent below that in 1929. Whereas military production had made up only 32 per cent of the total income of the engine building industry in 1929, it amounted to 63 per cent of the total last year.

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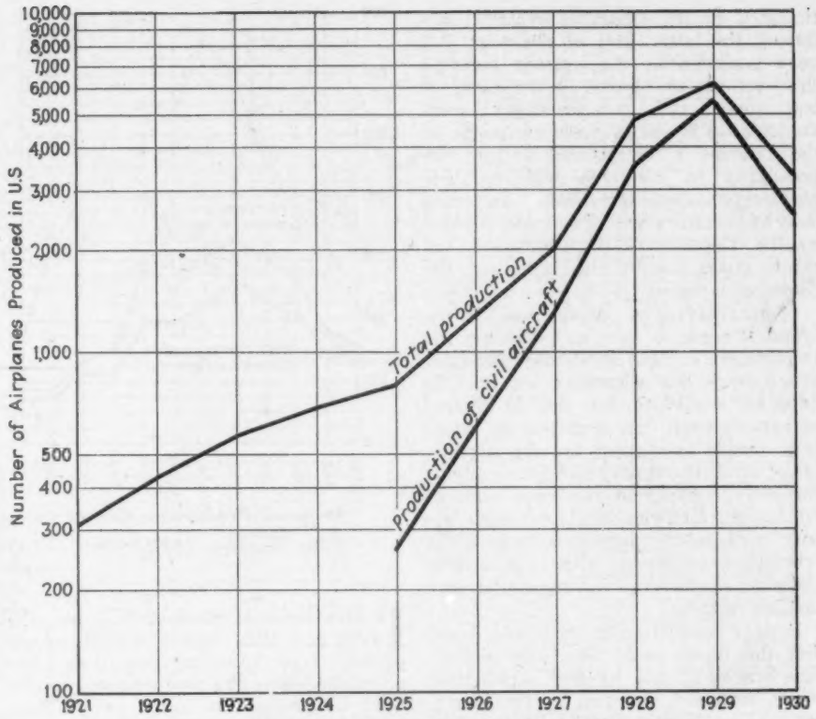
AN analysis of production for 1930 is given in two forms, drawn from the reports of the Chamber of Commerce and the Department of Commerce, respectively. Both are of course substantially correct so far as they go, but they represent somewhat different points of view. The report made by the Department includes all airplanes licensed and identified, but takes no direct account of the 250 machines destined for immediate export. The reports made to the Chamber cover practically all of the regular constructors of aircraft in any considerable numbers, except for a couple of important builders of low-powered monoplanes, who either made no reports to the Chamber of Commerce or par-



American Aircraft Production, 1921-1930

1930 Aircraft Production

	Department of Commerce Reports	Chamber of Commerce Reports
Landplanes	2,072	1,903
Open cockpit monoplanes	554	250
One-place	306	58
Two-place	207	166
Three-place	41	26
Cabin monoplanes	552	543
One-place	3	4
Two-place	112	29
Three-place	28	34
Four-place	257	276
Five-place	10	9
Six-place	63	109
Seven-place and up	79*	82*
Total monoplanes	1,106	793
Open cockpit biplanes	947	1,083
One-place	33	8
Two-place	346	421
Three-place	561	646
Four-place and up	7	8
Cabin biplanes	19	27
Total biplanes	966	1,110
Flying boats	108	17
Amphibions		17
Convertibles**	61	.....
Planes for experimental purposes	30	.....
Airplanes exported	250	.....
Total commercial planes	2,521	1,937
Military airplane deliveries	836	747
Grand total	3,357	2,684

*39 multi-engine transport planes included in Dept. of Comm. figure and 38 in Chamber of Commerce report.

**Chamber of Commerce classifies these under landplanes.

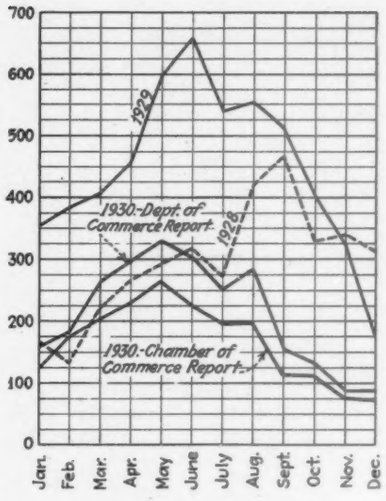
Style of Licensed Aircraft

Monoplanes		**2,483**
Open Cockpit		308
One-place	80	
Two-place	172	
Three-place and up	56	
Cabin		2,143
One-place	12	
Two-place	275	
Three-place	575	
Four-place	429	
Five-place	213	
Six-place	278	
Seven to ten-place	177	
Ten to fifteen-place	118	
Fifteen to twenty-place	60	
Twenty-place and up	6	
Flying Boats		12
Amphibions		19
Biplanes		**4,917**
Open Cockpit		4,620
One-place	129	
Two-place	941	
Three-place	3,485	
Four-place and up	65	
Cabin		123
Three-place	16	
Four-place	12	
Five-place	56	
Six-place	14	
Seven-place and up	25	
Flying Boats		39
Three-place and less	11	
Four-place	23	
Five-place and up	5	
Amphibions		135
Three-place and less	21	
Four-place	30	
Five to ten-place	34	
Ten-place and up	50	
Unclassified		**199**
Grand Total		**7,598**

ticipated in the Chamber reports only during the latter part of the year. A very considerable discrepancy between the two sets of figures in the cases of both one- and two-passenger open monoplanes is due to those omissions in the Chamber's report, and also to the popularity of the type with amateur builders of single machines. Airplanes built by amateurs are, of course, recorded by the Department of Commerce, but never come within the scope of the Chamber's notice.

If an analysis of "production" in the broadest sense is sought, therefore, the Department's figures should be consulted, with due allowance for the 250 exported machines and the 30 classed as experimental, not arranged by types. If a record is wanted for the product of the aircraft industry and for the number and grouping of machines built in established factories, the Chamber's report will serve better—although, as previously noted, it is not absolutely complete, especially in respect to the smallest planes.

In this connection it should be noted that the figure used for 1929 production, in the year-to-year production curve, was that obtained by the Chamber. The Department of Commerce made no analysis for that period, and the results from the Census of Manufactures were not available in time to be used in plotting the curve. It is probable that a corrected figure, including all planes built by amateurs or in shops not reporting to the Chamber, would show about 5,600 civil aircraft in 1929, instead of the 5,357 for which the curve is plotted. The 1930 point on the curve is taken from the complete figures of the Department.



Seasonal Production Curves by Months, 1928-1930

In the seasonal production chart, the 1928 and 1929 curves were approximated from licensing statistics, but probably follow the true seasonal variations of production fairly well. They have been adjusted so that the totals for the year are correct. There are curves for 1930. One is based on the monthly returns to the Chamber of Commerce and follows them directly, except for an adjustment in the first six months of the year to take care of the production of one important manufacturer who was not reporting at that time but began to do so later. The other is taken from the reports of the Department of Commerce, and includes machines listed for export as well as those licensed for home employment. The two curves follow the same general form except for a secondary peak in the Department's curve during August, probably attributable in large part to the growing interest in amateur construction of light planes at that time.

1929 and 1930 both approach what would seem the logical seasonal form, with a peak for the year reached somewhere between April and July, a gradual decline thereafter through August or September, and then a very sharp drop, due both to the decrease in flying activity and to the clearing of stock at the end of the year in anticipation of the appearance of new models. The drop in 1929 was, of course, abnormally rapid, corresponding as it did with the beginning of the business depression. The peak of 1928, conversely, was delayed by the effects of the "boom," factories not having been able to bring themselves up to a production capable of coping with the demand for aircraft during the early part of the summer.

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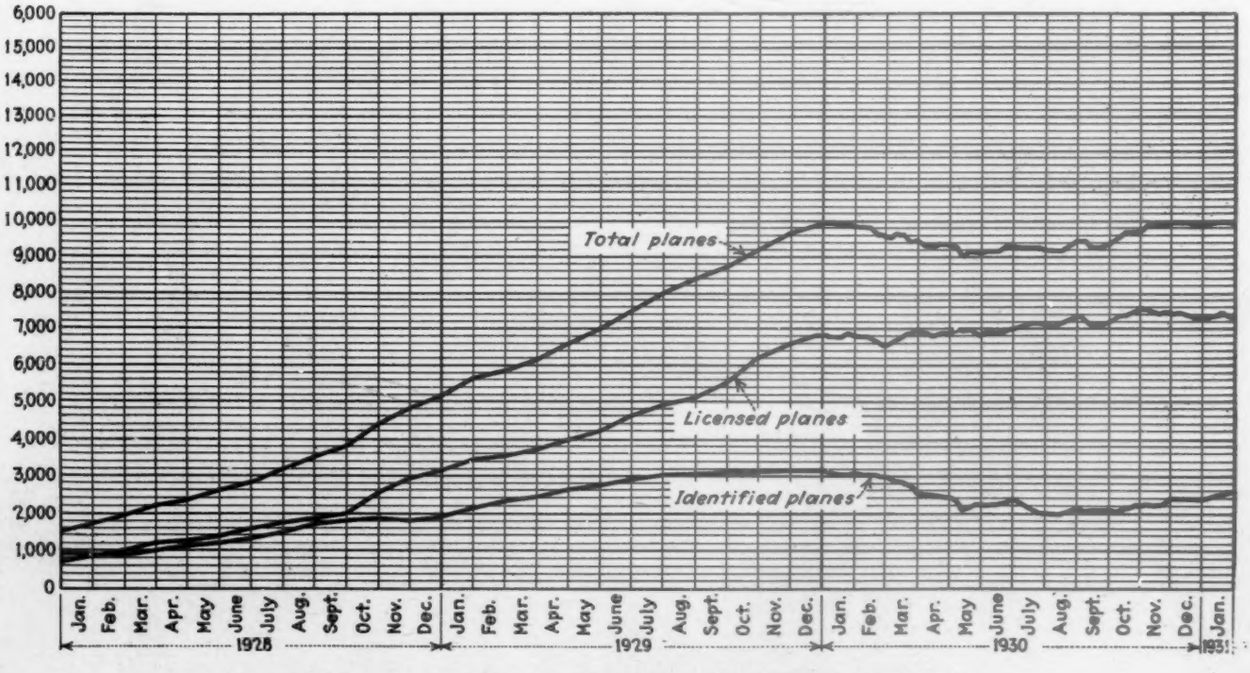
The curve of weekly variations of valid licenses and identifications outstanding shows some very curious aberrations over the past year. From the first of September, 1928, up to the end of November, 1929, the total number of planes officially recognized as in service has been increasing with almost perfect regularity at the rate of 400 per month. With the end of 1929, and of course immediately following on the stock market crash and the beginning of the general business depression, the rate of increase fell abruptly from 400 per month to zero, and through the past year there have been only minor



Valid Licenses and Identifications Outstanding from Week to Week

fluctuations. For more than fifteen months the total has never been below 9,000 nor above 10,000. The figure 10,000, in fact, seems to have an almost magical influence in checking growth. Repeatedly, for the first time in January of last year and on several occasions since, the total number of planes has risen above 9,950 and then slipped back without passing the 10,000 mark.

The curve of total planes in service inverted the normal seasonal tendencies during 1930. During the spring and early summer cancellations of old licenses and identifications, especially the latter, outran new productions. The number of machines in use reached a minimum near the height of the summer flying season and it has attained its maxima in the months, comparatively inactive in most parts of the country, January, November, and December.

In spite of the growing body of state law requiring federal licensing, the identified machine is by no means disappearing from the records.

There are fewer now than there were a year ago, whereas the number of licensed planes has increased, but the proportion of the total that hold licenses has never yet reached 80 per cent, and has actually fallen off a little in the last three months. The variations in the proportion of licensed planes among the several states are shown in the map on page 157.

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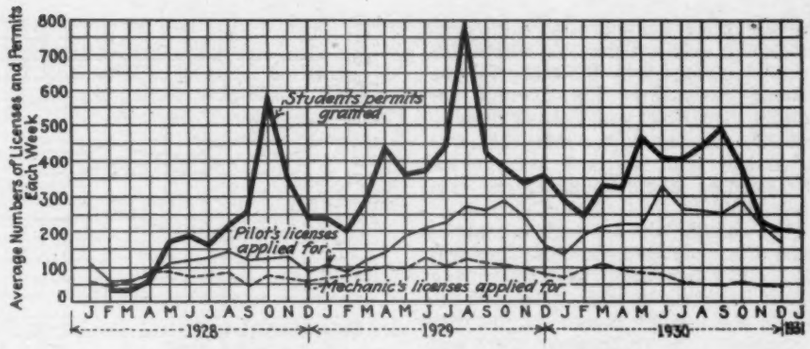
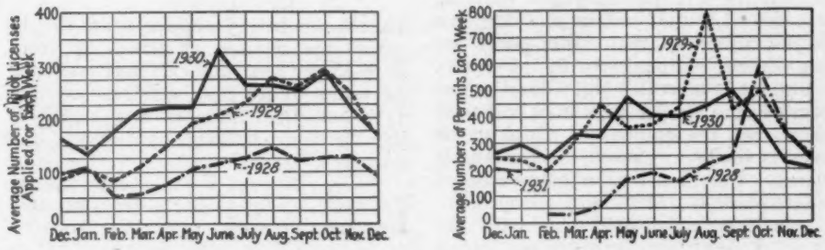
IN spite of business conditions, there has been no slackening off in the training of pilots during the past year. During the last five months of 1930 the curve of applications for pilot licenses followed that of the previous year almost exactly, with an average deviation of less than 10 per cent, while in the first seven months it had remained well above the 1929 level. Toward the end of the year the number of cancellations and licenses allowed to lapse began to catch up with the new issues, and during November and December the number of licenses in force increased by only a little over 2 per cent. The absolute increase in the number of licensed pilots was approximately 5,300 during 1929, and 5,100 during 1930.

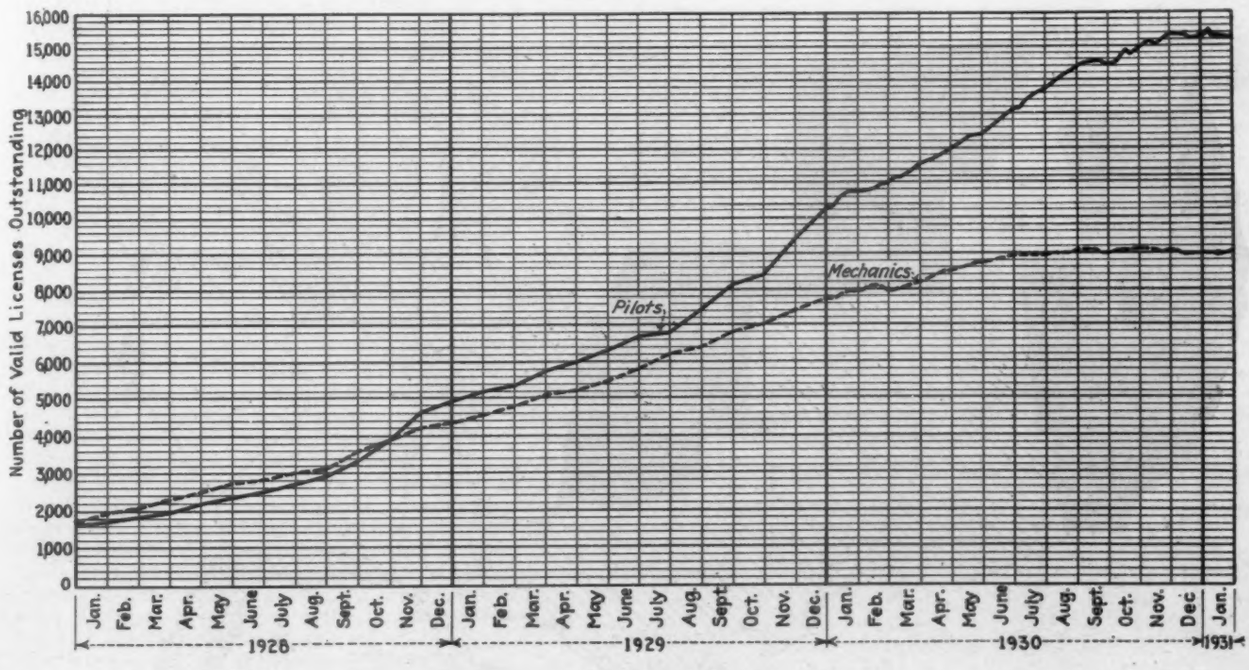
The student permit curve for 1930 also stayed very close to that for 1929 throughout the year, except that there was no such sudden jump in August as there had been in the previous year.



Rate of Application for Personnel Licenses



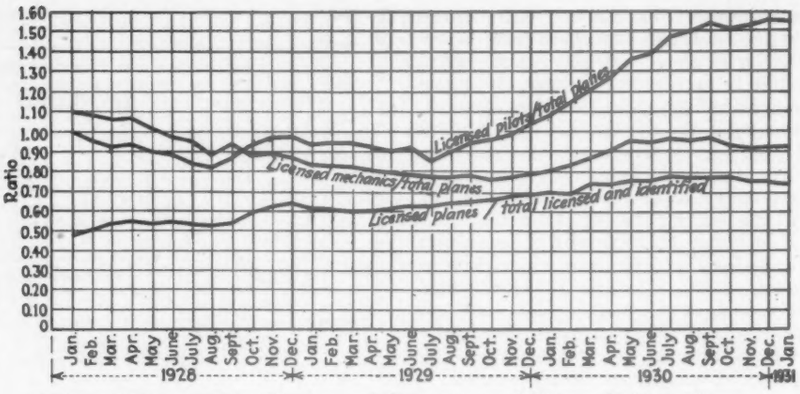
Seasonal Curves, Pilots Licenses (left) Student Permits (right)



Progress of Personnel Licenses

The reason for that sharp increase is not quite clear, unless it may have been due to interest aroused by the plans for the national air races. The average for the first three weeks of 1931 is running about 20 per cent lower than the same period last year, and the average for pilot licenses issued about 15 per cent below 1930.

The number of licensed mechanics seems to have attained absolute stabilization. After increasing by 3,300 during 1929 it has gone up only 1,300 in 1930, and for the last six months of the year it remained always between 8,900 and 9,100, or just a little less than one mechanic per airplane in service. The ratio of pilots to planes, in the meantime, has been increasing quite steadily and for the last two months of the year was over 1.5. Of course this does not necessarily mean that 5,000 pilots are left without equipment to fly. Properly maintained aircraft will stand more hours in the air per year than will their pilots, and the number of pilots on air lines is likely to exceed the number of planes. Furthermore, in many cases a single plane is owned by a group of individuals or a club and serves to keep all of them regularly in practice, while another factor is the presence on the list of licensed pilots of a large number of Army and Navy officers who do their regular flying on service equipment. These factors are considerably more potent for the airplane than for the automobile, and yet the number of automobile drivers' licenses habitually exceeds the number of cars registered by about 10 per cent. It is wholly natural that the number of airplane pilots should exceed the number of planes by from 20 to 35 per cent, and certainly not until the latter figure has been reached can it be felt that there is any excessive disproportion between personnel and machines.

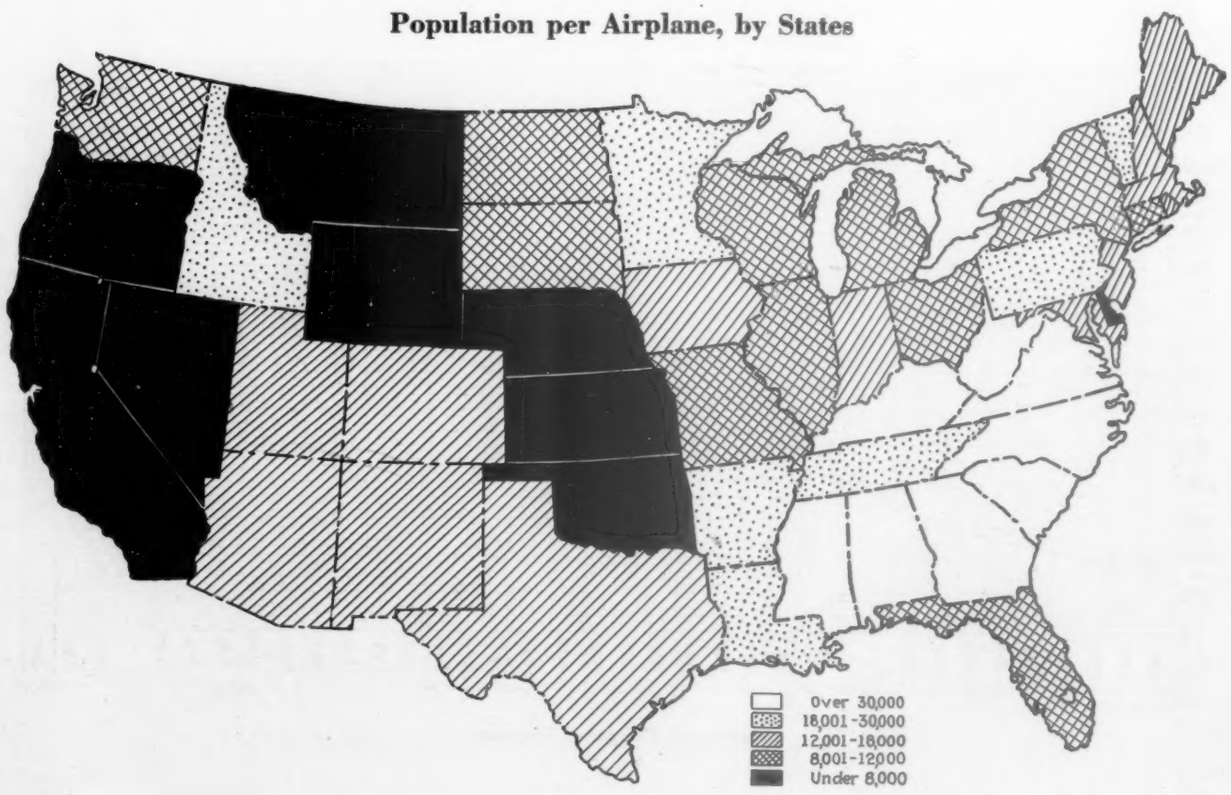


Ratios of Personnel to Planes, and Proportion of Planes Having Licenses

In spite of the shift towards the east during the past year, the western states remain by far the largest users of aircraft in proportion to their population. There are eight western states in which there is at least one airplane to every 8,000 of population, while east of the Mississippi only Delaware and the District of Columbia have attained that standard. On the other hand the states that stand at the end of the scale, those with more than 30,000 inhabitants per plane, lie in the geographical block in the southeast—a confirmation of the suggestion made elsewhere that that region has not been exploited to anything like its full possibilities as a market. Although California no longer has a larger number of airplanes in use than any other state it still heads the list of relation of planes to population by a considerable margin. If the figures were literally representative of actual use the margin would be still larger than it is, for California's nearest competitor, Wyoming, has its total padded considerably by the registration there of transport planes operating outside of the state much of the time.

On the whole, the tendency is towards an equalization of distribution of airplanes over the country. Although the total number of machines in use is almost exactly the same as a year ago,

Population per Airplane, by States



and although the present map is based on the 1930 Census, and therefore on a population somewhat larger than its predecessor, states having more than 25,000 population per plane have been reduced in number from fifteen a year ago to nine now.

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THE analysis of licenses and identifications granted during the past year is on quite a different basis from the corresponding table in the statistical issue of 1930. At that time there was no way of distinguishing between genuinely new licenses on new aircraft and re-licenses on machines on which the licenses had been allowed to lapse. The table printed a year ago is therefore only a rather rough indication of the previous year's production. Furthermore, the 1930 issue included only licensed planes, whereas both licenses and identifications are taken into account now. It is now possible, thanks to the action of the Chamber of Commerce in making suitable indications on its weekly lists, to distinguish the machines which have never been licensed or identified before, and only such machines are included in the present tabulation. It therefore represents a very good approximation to current production of new planes, except that: (1) machines exported elsewhere than to Canada (they are usually delivered to that country by air, and consequently take a U. S. identification mark) are generally excluded; (2) the tabulation includes about 100 machines built late in 1929, but licensed or identified during 1930; (3) most of the production of the last three weeks of 1930 is omitted; (4) a small number (probably not over 30) of old airplanes have just been brought out of storage or re-imported, and were consequently licensed or identified for the first time in 1930. The actual error in this table as a production estimate should not exceed ten per cent at most, but it should be realized that some error does exist, and that it is not uniform nor always in the same direction for the various makes. The figures must be broadly interpreted, and not taken as rigorously representative of the individual production of the several factories, nor as anything else except what they purport to be, a listing of the licenses and identifications actually granted.

There is no evidence, in this record of the distribution of the year's output, of any tendency toward concentration of control of the industry in the hands of a few companies. Of the total number of newly licensed machines, only 39 per cent were produced by the five largest companies or groups (counting Curtiss-Wright or United, for example, as one company). 57 per cent by the largest ten. In the automobile industry, on the other hand, the production of the ten largest manufacturers is somewhere around 93 per cent of the total. There were 17 plane companies which contributed over one per cent each to the 1930 production. It is frequently said that a hundred or more companies are active in aircraft production in the United States, but only about a score of them make any important contributions to the year's production total. Of course too much importance must not be attached to these figures, for 1930 was an exceptional year, and some of the larger companies were much more concerned with working off a surplus inventory than with producing new stock. It is probable that an analysis of the number of planes sold, rather than of the number produced, and eliminating amateur construction would show the ten largest companies controlling about 75 per cent of the market, still measuring by number of units, not by total value.

The same qualifying observations that were made for the table of recent plane licenses apply also to the engine table at the bottom of the column. As might have been expected, the engine figures reveal a much greater measure of concentration in manufacture. Eliminating the war surplus engines from consideration, two manufacturers were responsible for 37 per cent of all the engines produced, five for 63 per cent, and 10 for 82 per cent. The manufacture of airplane engines, in other words, shows a degree of concentration rapidly approaching that of the manufacturer of automobiles,—which is of course logical, for airplane engines like automobiles are factory products, imposing at the minimum a much larger amount of specialized machinery than is needed for building planes.

The most interesting point about the quarterly tabulations, however, is the very rapidly decreasing importance of the war surplus power plants in new production. Through 1929 the OX-5 and OXX-6 alone must have been installed in around 25 per cent of the airplanes built, while the Hispano took another 3 per cent. In 1930 the total for all war surplus types together is down to 12 per cent, and in the last half of the year to 10. The statistical indication is strong that by the end of 1932 the wartime power plant will appear in a new machine only as an occasional curiosity.

Licenses and Identifications Recently Granted by Makes, Quarterly for 1930

	Jan. to Mar.	Apr. to June	July to Sept.	Oct. to Dec.	Total
Aeromarine Klemm.	4	13	12	6	35
Aeronca	14	71	6	6	97
American Eagle	15	29	43	28	115
Bellanca	8	5	11	12	36
Bird	6	17	37	15	75
Cessna	4	5	5	...	13
Command-Aire	5	6	9	3	24
Consolidated	17	51	45	25	133
Commodore	*2*	*2*	*1*	*4*	*9*
Fleet	*14*	*48*	*43*	*19*	*124*
Fleetster	*1*	*1*	*1*	*2*	*5*
Curtiss-Wright					
Curtiss	4	...	...	2	6
Curtiss-Robertson	13	16	4	11	44
Keystone-Loening	7	8	18	3	36
Travel Air	31	17	29	13	90
Biplane	*24*	*12*	*22*	*9*	*67*
Monoplane	*7*	*5*	*7*	*4*	*23*
Davis	3	7	6	1	17
Detroit Aircraft					
Detr. Fb. and Amph	4	4	5	1	14
Lockheed	3	8	10	4	25
Ryan (incl. Parks)	14	5	7	1	27
Eaglerock	22	38	11	5	76
Fairchild (Incl.Chall.)	24	19	13	7	63
Monoplanes	*3*	*1*	*2*	*2*	*8*
Biplanes	*21*	*18*	*11*	*5*	*55*
Fokker	7	4	4	4	19
1 Engine	*7*	*1*	*1*	*2*	*11*
4 Engines	*0*	*3*	*3*	*2*	*8*
Ford	3	5	5	2	15
Great Lakes	13	19	40	9	81
Heath	9	6	24	7	46
Inland	1	1	7	6	15
Ireland Amphibions.	4	1	...	3	8
Lincoln	14	21	13	1	49
Mono Aircraft	14	31	41	18	104
Moth	33	23	4	6	66
New Standard	3	5	10	4	22
Nicholas Beasley	..	8	6	3	17
Pitcairn	5	8	4	5	22
Savoia-Marchetti	11	7	8	...	26
Spartan	14	7	...	1	22
Stinson	14	60	122	27	223
4 Place	*14*	*60*	*117*	*25*	*216*
11 Place	..	...	*5*	*2*	*7*
Swallow	4	2	3	...	9
United Aircraft					
Boeing	2	1	2	5	10
Sikorsky	7	4	7	7	25
Stearman	9	4	12	6	31
Viking (incl. Kit. H'k)	9	1	4	3	17
Waco	32	50	114	31	227
Miscellaneous	94	105	138	111	448
Total	500	692	839	402	2,433

Engines in Planes Licensed or Identified for the First Time, Quarterly for 1930

	Jan. to Mar.	Apr. to June	July to Sept.	Oct. to Dec.	Total
Aeronca	14	72	7	7	100
American Cirrus	14	23	46	17	100
Curtiss	16	12	8	3	39
Kinner	78	126	131	51	386
Lambert Velie	20	45	49	16	130
Le B'ond	11	16	19	5	51
Lycoming	3	55	108	26	192
P & W Hornet	9	12	8	12	41
P & W Wasp	38	31	42	32	143
Wright Cyclone	1	0	1	3	5
Wright Gipsy	33	22	7	2	64
Wright Whirlwind	99	76	85	38	298
Warner Scarab	8	28	101	39	176
Miscellaneous	33	67	116	90	306
War Surplus Engines					
Hisso	16	24	2	7	49
Liberty	0	0	0	2	2
OX5	67	65	74	28	234
OXX6	8	2	10	2	22
Foreign engines*	32	16	25	22	95
Total	300	692	839	402	2,433

*Mostly Salmson, Anzani, and LeRhone engines

IN CLASSIFYING licensed aircraft by types, seating capacity, and state of domicile, we have made one notable change from the form of the same table a year ago. The aquatic status of float seaplanes and convertible machines has been ignored in making up the table. They have all been listed as landplanes. Strictly speaking, practically all small airplanes are convertible, and undoubtedly a number of machines have been used with float gears attached without any mention of the fact ever being made in the lists of licenses. The very small figures given for seaplane licensing in the 1930 statistical number were, therefore, likely to lead to an underestimate of the actual amount of seaplane operation. It seems better to abandon the distinction entirely. Machines definitely designed for marine use, flying boats and amphibions, of course continue to receive separate identification.

Taken together with the general national summary of types and sizes on page 137 the table shows, even more clearly than the study of new production, some interesting tendencies in the choice of types by the ultimate consumer. For example, the three-seater open biplanes have gained almost no ground. New registrations have been virtually offset by cancellations. Three-seater cabin monoplanes have likewise remained practically static. Four-passenger monoplanes, on the other hand, have made such progress that they have almost caught up with the three-seaters in numbers, and six-passenger cabins, which out-numbered the five-passenger ones by only about 10 per cent a year ago, made further relative gains. Among the cabin biplanes, on the other hand, the five-passenger machine sweeps the field, but that is accounted for in part by the popularity of a single type carrying a large cargo of mail and four passengers in addition to the pilot. For totally enclosed passenger types, not intended for handling mail, there is an apparent tendency towards even numbers of seats. Popularity of the three-seater is an exception to a general rule.

The open-cockpit two-seater has made notable strides, both among the monoplanes and the biplanes. There, too, the even number is in the ascendent.

One-passenger landplanes, and one-passenger flying boats and amphibions as well, are usually designed for mail carrying. Their nominal passenger capacity is no index to their size.

Distribution over the country is of course far from uniform for the various types. In states where the climate is not unduly severe, and where the airplane is used principally as a means of travel for individual business men, the open three-seater usually reigns supreme. In the states in the midwest and southwest it accounts for about one-half of all licenses, while in New England, New York and New Jersey, its share drops to less than 40 per cent. Farther north in the middle west, as in Ohio, Minnesota, and the Dakotas, the small cabin machine shows much greater strength, running up to 25 or 30 per cent of the total of licenses, while in most of the southern states cabin machines of four-passenger capacity or less represent only about 15 per cent of the total. The climatic influence is very clearly displayed.

Cabin machines of five to seven passenger capacity, excluding from consideration the effect of transport line ownership and of concentration of certain types of planes in the neighborhood of the factory where they were built, make their best showing in California, Texas, Oklahoma, and the north central states, poorest in the eastern central area. Fast monoplanes of that size have been particularly popular for transport over the Texan plains in connection with the oil business.

It is hardly possible to draw any detailed conclusion from the geographical distribution of machines of still larger size, as most of them are in use on transport lines and are as a rule all licensed in the state in which the operating company has its home office. At most, licensing of the planes operated by an airline may be distributed over three or four states, and usually in a manner having little reference to the actual amount of operation within the state boundaries. Thus, for example, a considerable proportion of the 38 landplanes of ten-passenger capacity or more that are registered in New York are owned by Pan-American and Pan-American-Grace Airways, and are operated entirely outside of the continental United States. The concentration of very large cabin biplanes in Washington and Wyoming, similarly, is of course due to their use on the Boeing lines, although practically none of the service of those multi-engined machines is rendered within the state of Washington and only a small part of it in Wyoming.

There has been a considerable increase in the number of amphibions licensed and an increase also in their variety. A year ago a total of 80 in that class were listed and 79 of them were biplanes. Now the total is up to 154, including 19 monoplanes. The geographical distribution, however, remains about as concentrated as before. Of 28 open biplane amphibions, 21 are in New York. Of 107 cabin biplanes, New York claims 45, Pennsylvania 15, and Connecticut 11, two-thirds of the total number in three states. The 19 monoplanes are somewhat more widely scattered.

Transport line ownership plays a large part in accounting for this apparent concentration of amphibion ownership, for of the 29 amphibious planes with a capacity of ten passengers or more that are licensed in New York, a large portion are the property of the Pan-American Company. Even with allowance for that, however, and for the effect of stock in storage at amphibion factories located in New York, Connecticut, and Pennsylvania, it remains true that the operation of such machines is concentrated to a surprising degree. Sportsmen around New York and sportsmen in Chicago have been purchasers, and that seems to have exhausted the market to date. California, with 800 miles of coastline, has only seven amphibions, and a year ago there were but four listed in the state.

State	Open Biplanes										
	Landplanes							Amphibions			
No. of passengers	1	2	3	4	5	7	9	20	1	2	3	5
Alabama		3	14									
Arizona		5	13									
Arkansas		2	35									
California	8	133	459			1						
Colorado		5	25									
Connecticut		25	42		7							
Delaware		7	9									
Dist. of Col.	1	4	29		3							
Florida		16	40									1
Georgia		4	22		1							
Idaho	1		13									
Illinois	24	66	235		1						2	
Indiana	2	15	85									
Iowa		10	60		1							
Kansas	1	18	104		1							
Kentucky		4	20									
Louisiana	4	9	33									
Maine		7	10		1							1
Maryland		13	42									
Massachusetts	1	43	92		1						2	
Michigan	1	42	156									
Minnesota	1	13	52									
Mississippi		5	18									
Missouri	4	32	114									
Montana		6	27									
Nebraska		33	57		1							
Nevada		1	5									
New Hampshire		4	15									
New Jersey	1	23	76	1	11							
New Mexico		4	10									
New York	21	158	413	3	15				1	1	14	5
North Carolina	1	5	27									
North Dakota			20									
Ohio	9	57	203		1							
Oklahoma		18	123									
Oregon	3	10	41									
Pennsylvania	11	49	231		1							
Rhode Island		2	15		1							
South Carolina		2	11									
South Dakota		2	33									
Tennessee		15	33	1								
Texas	14	31	141			1						
Utah	1	2	15									
Vermont		2	11		1							
Virginia		4	32		1							
Washington	9	12	76					8			1	
West Virginia		5	19									
Wisconsin		13	109		1							
Wyoming	11		14									
Alaska		1	4		1							
Hawaii			2									
Foreign		1										
Total	129	941	3485	5	50	1	1	8	1	1	19	7

For flying boats a similar story has to be told, except that the total numbers are still smaller. There were only 51 flying boats licensed in the United States at the beginning of this year, an increase from 44 a year earlier. Sixteen of the number are located in New York, 14 in Michigan, and the other 21 are scattered among eight or ten states. California and Illinois have not a single one. Wisconsin, with a splendid lake frontage, shows only one flying boat and no amphibions, while Ohio has only two boats. Nothing could point more discouragingly than these figures either to the lack of a market for marine aircraft or failure to develop the market where it exists.

Classification of Licensed Aircraft by State, Type and Capacity

| | Flying Boats | | | | Cabin Biplanes | | | | | | | | | | | | | | | | | | | | | | | | | | | Open Monoplanes | | | | | | | | | | | Cabin Monoplanes | | | | | | | | | | | | | | | | | | | | | | | | | | Unclassified | Total |
|---|---|---

Airplane	Alabama	Arizona	Arkansas	California	Colorado	Connecticut	Delaware	Dist. of Columbia	Florida	Georgia	Idaho	Illinois	Indiana	Iowa	Kansas	Kentucky	Louisiana	Maine	Maryland	Massachusetts	Michigan	Minnesota	Mississippi	Missouri	Montana	Nebraska	Nevada	New Hampshire	New Jersey	New Mexico	New York	North Carolina	North Dakota	Ohio	Oklahoma	Oregon	Pennsylvania	Rhode Island	South Carolina
Alexander	...	2	...	66	13	2	...	...	9	2	5	22	11	6	4	1	3	2	2	10	20	9	4	11	3	12	...	...	7	2	30	4	4	11	12	10	18	1	5
American Eagle	5	1	12	27	...	...	...	...	1	...	...	10	7	9	33	...	3	1	...	6	9	9	...	22	5	5	...	1	2	1	23	1	3	11	11	2	7	1	1
Arrow	...	...	...	3	...	...	...	...	...	...	...	...	1	2	...	...	...	...	...	3	2	1	...	5	1	16	...	1	...	...	8	...	...	...	1	1	...	...	...
Avro-Avian	...	...	...	6	...	8	...	...	1	...	...	10	1	...	...	...	...	...	2	2	1	...	...	...	...	...	...	...	1	...	9	...	...	4	...	...	2	1	...
Bellanca	...	...	...	4	...	1	16	...	1	1	1	7	...	...	...	...	...	1	2	3	1	1	...	3	...	2	...	...	3	...	5	...	...	2	2	...	4	...	...
Bird	1	...	...	5	...	6	1	2	4	3	...	4	...	2	...	...	...	...	1	2	3	...	...	1	...	...	...	1	2	...	40	...	...	14	1	1	12	2	...
Boeing	...	...	...	23	...	2	...	1	...	...	...	7	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	1	5	1	...	...
Buhl	...	...	...	7	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	1	12	...	...	...	1	...	...	...	...	...	1	...	...	2	7	...	...	...	...
Cessna	...	...	...	7	1	3	...	...	4	...	...	5	2	1	8	2	...	...	2	3	2	1	1	3	...	2	...	...	2	1	22	1	...	3	7	...	...	...	...
Command-Aire	...	...	15	14	4	...	...	2	1	3	...	13	4	...	2	3	3	2	4	6	4	3	8	3	1	1	...	...	3	...	26	2	...	6	5	...	6	1	...
Consolidated (incl, Fleet)	...	...	...	60	1	9	2	3	4	1	...	10	1	3	...	...	5	...	2	4	10	...	1	14	1	2	...	...	3	3	83	...	...	10	7	2	16	...	...
Curtiss	...	...	...	5	...	4	...	...	3	1	...	19	3	...	3	2	...	1	2	4	5	...	...	2	...	1	...	...	1	...	22	2	...	2	1	...	2	...	...
Curtiss-Robertson	2	2	3	50	5	8	...	...	11	3	2	40	19	18	5	8	1	4	9	18	16	16	1	42	4	15	1	1	18	1	71	5	5	24	18	3	22	1	2
Fairchild (incl, Challenger)	1	1	...	17	...	13	4	5	2	1	...	16	3	3	...	1	...	1	24	6	13	1	...	3	...	...	...	1	9	1	103	4	...	9	...	1	69	3	2
Fokker	...	...	...	34	3	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	2	7	...	9	...	...	...	...	18	...	14	...	...	1	...	...	...	...	...
Ford	...	...	...	15	...	2	...	1	...	...	...	12	...	...	...	...	...	...	...	2	16	1	...	7	...	...	...	...	1	...	30	...	...	4	2	...	2	...	...
Great Lakes	...	2	...	20	1	...	...	...	2	...	...	8	1	2	1	...	...	...	...	1	5	6	...	2	2	1	...	2	1	...	12	...	...	20	4	5	5	...	...
Keystone (incl. Loening)	...	...	...	6	...	...	...	...	1	...	...	1	...	...	...	...	3	...	...	1	3	...	...	...	...	...	...	...	2	...	13	...	...	4	...	...	15	...	...
Lincoln	2	...	...	24	1	...	...	...	1	1	...	6	...	7	8	...	8	...	...	...	2	...	...	3	2	20	1	...	...	1	2	...	...	4	1	1	4	...	...
Lockheed	...	...	...	17	...	...	...	...	...	1	...	3	...	...	...	...	5	...	...	1	5	1	...	5	1	...	...	...	...	1	10	...	1	1	4	1	...	...	...
Mono Aircraft	1	4	...	43	1	1	...	1	5	1	...	35	4	14	6	...	...	...	...	2	14	6	...	11	...	6	...	1	2	1	15	6	7	19	9	2	24	...	0
Moth	...	1	1	13	3	...	2	2	3	1	...	6	1	2	...	1	2	4	1	20	4	...	...	4	1	3	1	...	7	...	20	2	...	5	2	...	7	...	1
New Standard	...	...	...	2	...	9	...	3	...	...	...	...	...	...	...	...	...	...	1	3	2	...	...	...	...	...	...	...	20	...	17	...	...	1	...	...	5	2	...
Nicholas-Beazley	2	...	...	9	...	2	...	...	1	...	1	1	2	1	1	...	...	...	...	...	3	...	1	15	2	1	...	...	...	...	...	1	...	1	1	...	2	...	...
Pitcairn	...	...	...	3	...	...	...	4	...	1	...	...	1	...	...	...	1	...	...	...	1	...	...	2	...	...	...	...	3	...	26	3	...	4	...	...	28	1	1
Ryan(incl, Parkes)	1	2	...	30	2	...	...	1	...	...	1	21	6	2	3	2	6	...	...	3	12	1	...	26	...	2	1	...	2	1	8	...	2	7	6	2	10	1	...
Savoia-Marchetti	...	...	...	1	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	16	...	...	...	...	...	...	...	...
Sikorsky	...	...	...	...	...	17	...	...	...	...	...	7	...	...	...	...	1	...	...	1	...	...	...	1	...	...	...	...	...	...	36	...	...	1	...	...	1	...	...
Spartan	...	...	...	7	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	3	3	3	...	...	...	1	...	...	2	1	2	...	...	...	52	...	2	...	...
Stearman	...	...	...	51	...	1	1	8	...	...	2	11	3	2	6	2	7	1	...	11	4	...	...	7	1	...	...	...	3	...	18	...	...	5	6	4	...	1	...
Stinson	...	2	4	40	3	4	1	18	5	3	1	31	5	9	5	...	3	...	...	3	38	14	2	8	4	7	...	1	9	1	40	3	3	16	16	5	19	2	...
Swallow	3	1	1	22	1	...	...	...	3	...	1	15	3	...	18	...	...	...	2	...	3	3	1	4	...	...	...	...	2	...	7	...	1	13	2	...	6	...	...
Travel Air	2	2	6	129	4	10	...	6	7	7	2	54	24	12	44	3	10	6	8	23	33	10	2	35	10	22	2	3	18	4	86	3	5	44	35	12	53	...	...
Waco	4	6	6	108	4	7	3	4	15	10	2	78	44	24	8	12	6	2	7	26	61	17	7	24	6	12	2	9	37	...	140	12	8	100	14	14	67	3	2
Miscellaneous	1	3	3	137	2	15	3	8	11	3	4	66	9	5	37	2	17	2	5	29	52	13	1	23	0	16	0	2	32	2	92	1	2	72	22	9	15	9	0
Total	25	29	51	1005	49	126	34	70	95	43	22	520	155	124	193	39	84	27	74	199	361	123	29	296	45	147	8	23	210	21	1047	50	41	420	249	80	429	30	15

Engine	Alabama	Arizona	Arkansas	California	Colorado	Connecticut	Delaware	Dist. of Columbia	Florida	Georgia	Idaho	Illinois	Indiana	Iowa	Kansas	Kentucky	Louisiana	Maine	Maryland	Massachusetts	Michigan	Minnesota	Mississippi	Missouri	Montana	Nebraska	Nevada	New Hampshire	New Jersey	New Mexico	New York	North Carolina	North Dakota	Ohio	Oklahoma	Oregon	Pennsylvania	Rhode Island	South Carolina
Aeronca	...	2	...	2	...	2	...	...	4	...	2	...	...	...	...	1	...	...	...	2	...	...	...	...	...	8	...	...	...	...	4	...	...	24	1	1	3	3	...
Axelson	...	...	...	8	...	...	...	...	...	...	...	4	...	...	3	...	...	...	...	...	1	...	...	1	...	...	...	...	1	2	1	...	...	1	...	...	1	1	...
Cirrus	...	2	2	30	1	9	...	...	3	...	...	20	2	2	1	...	1	...	2	5	6	6	...	2	2	1	...	2	3	...	22	...	...	25	4	9	8	1	...
Continental	...	...	1	2	...	...	2	...	...	...	...	...	...	...	3	...	...	...	...	...	6	...	...	1	...	...	...	...	...	...	2	...	...	4	...	...	...	...	...
Curtiss (Challenger)	...	2	3	38	7	8	1	...	8	3	...	24	7	3	6	7	1	5	8	16	26	4	...	24	2	7	1	...	10	1	55	3	...	9	15	...	12	...	2
Gypsy	...	1	1	12	3	4	2	...	3	1	...	6	1	2	1	1	1	4	1	19	4	...	...	5	1	3	1	...	8	...	22	2	...	5	2	...	7	1	...
Kinner	3	3	6	103	2	16	2	3	9	3	...	17	6	14	22	...	9	1	7	22	18	10	1	20	3	16	...	1	13	2	132	1	...	33	9	5	33	2	...
Le Blond	2	1	1	20	...	1	...	2	...	...	...	9	4	2	11	1	...	...	1	4	8	2	1	8	1	12	...	1	13	...	12	2	...	3	4	1	4	1	...
Lycoming	...	1	...	24	2	1	1	13	4	3	1	19	3	5	1	...	1	...	...	2	13	6	1	3	1	3	...	1	6	...	17	1	2	4	5	2	14	2	...
P. & W. Hornet	...	...	...	28	...	2	...	...	1	...	...	9	2	...	...	...	1	...	...	...	2	4	...	2	...	...	...	...	5	...	23	...	...	1	1	5	...	1	...
P. & W. Wasp	...	...	...	80	3	21	3	4	1	1	...	29	3	2	7	1	7	...	...	3	16	10	1	25	2	2	...	...	11	1	114	1	1	16	14	1	9	1	...
Velie	1	4	...	47	1	1	...	...	5	1	...	24	5	13	9	...	...	...	...	1	19	5	...	14	...	10	...	1	2	1	14	4	9	16	18	2	26	1	...
Warner Scarab	1	2	1	26	3	10	1	...	6	2	...	23	6	4	12	3	1	...	3	12	22	5	6	20	2	5	...	...	19	3	60	5	2	25	18	...	27	2	...
Wright Cyclones	...	...	...	4	...	...	1	1	...	...	...	...	...	...	...	...	1	...	...	...	3	...	...	...	...	...	...	...	2	...	4	...	...	3	...	2	...	...	...
Wright Whirlwinds	3	3	6	210	7	20	12	36	6	8	7	93	19	12	34	6	34	6	20	40	83	18	3	72	9	12	3	5	48	8	230	3	3	69	75	11	90	4	...
Miscellaneous	1	0	4	41	2	7	3	1	2	0	1	20	11	2	7	1	1	0	6	13	19	4	1	15	2	4	1	1	13	0	44	1	1	18	24	3	22	3	0
Total	11	21	25	675	31	102	28	60	52	22	11	297	69	61	117	21	58	16	48	139	246	74	14	212	25	83	6	12	154	18	756	23	18	256	190	42	256	19	4
War Surplus																																							
OX5	13	7	25	262	8	21	5	6	34	20	6	186	76	57	61	14	17	9	25	46	104	44	14	73	18	53	1	7	51	2	269	26	19	144	53	28	159	8	9
OXX6	...	1	1	16	...	2	1	1	5	...	1	3	...	3	9	2	1	1	1	8	6	1	1	3	...	7	...	1	1	...	5	1	...	11	2	1	4	2	...
Hispano Suiza	1	...	...	42	10	1	...	1	3	1	4	9	10	3	6	2	7	1	...	6	4	4	...	8	2	4	1	3	4	1	14	...	4	9	4	9	10	1	2
Liberty	...	...	...	10	...	...	...	2	1	...	...	25	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	3	...	...	...	...	...	...	...	...
Total	14	8	26	330	18	24	6	10	43	21	11	223	86	63	76	18	26	11	26	60	115	49	15	84	20	64	2	11	56	3	291	27	23	164	59	38	173	11	11
Grand total	25	29	51	1005	49	126	34	70	95	93	22	520	155	124	193	39	84	27	74	199	361	123	29	296	45	147	8	23	210	21	1047	50	41	420	249	80	429	30	15

Rhode Island	South Carolina	South Dakota	Tennessee	Texas	Utah	Vermont	Virginia	Washington	West Virginia	Wisconsin	Wyoming	Alaska	Hawaii	Foreign	Total
1	5	18	3	25	6	...	11	15	4	9	5	1	...	...	420
1	1	4	...	14	...	...	...	2	...	11	1	...	...	...	261
...	...	...	1	...	...	...	...	5	...	...	...	...	...	...	51
1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	48
...	...	...	1	4	...	...	...	...	1	1	...	...	1	...	68
2	...	...	...	1	...	...	1	...	...	1	1	...	...	...	112
...	...	...	...	...	1	...	...	54	...	...	32	...	...	...	128
...	...	...	...	1	...	...	...	3	1	...	...	...	...	...	38
...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	85
1	...	...	4	26	...	1	...	2	...	1	...	...	...	...	179
...	...	...	3	8	...	1	...	6	1	8	...	...	...	...	284
...	1	...	1	2	...	...	...	...	...	...	...	...	...	...	89
1	2	6	13	29	1	...	3	2	2	10	1	...	...	1	543
3	2	1	2	8	1	1	2	1	1	9	...	4	...	...	342
...	...	...	...	13	4	...	1	...	...	...	...	...	...	...	107
...	...	1	...	13	...	...	...	2	...	...	...	...	...	...	111
...	...	2	3	1	1	...	1	...	1	1	...	...	...	...	113
...	...	...	1	...	...	...	...	2	...	...	...	1	...	...	53
...	...	2	...	1	...	...	1	...	...	1	1	...	...	...	105
...	...	...	...	10	...	...	...	...	3	...	...	...	...	...	70
...	0	7	3	8	...	...	1	2	1	14	1	...	...	...	278
...	1	...	2	5	...	1	2	...	2	2	...	...	...	...	134
2	...	...	...	2	...	1	1	...	...	...	...	1	...	...	70
...	...	...	...	1	...	...	...	...	1	...	1	...	...	...	50
1	1	...	...	5	...	...	1	...	...	...	...	...	...	...	85
1	...	4	...	14	1	...	2	5	...	6	...	...	...	...	193
...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	22
...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	68
...	...	...	...	5	...	...	...	...	...	...	...	...	...	...	83
1	...	1	1	3	3	...	...	5	...	5	...	...	...	...	168
2	...	...	9	18	...	2	2	6	2	9	1	4	...	...	378
...	...	...	4	13	1	1	...	5	...	4	3	1	...	...	146
...	...	7	10	57	8	2	7	9	4	22	6	...	2	...	870
3	2	1	17	33	...	7	9	18	9	51	...	1	...	...	1057
9	0	1	4	16	0	0	4	13	0	18	0	0	0	1	792
30	15	55	83	336	27	17	49	161	30	178	51	15	6	2	7598

Rhode Island	South Carolina	South Dakota	Tennessee	Texas	Utah	Vermont	Virginia	Washington	West Virginia	Wisconsin	Wyoming	Alaska	Hawaii	Foreign	Total
3	...	...	1	...	...	...	...	...	...	...	...	...	...	...	60
...	...	1	...	1	...	...	...	...	...	2	2	...	...	...	29
1	...	2	3	1	1	...	1	...	1	1	...	...	...	...	181
...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	22
...	2	...	10	33	1	1	2	20	1	3	...	...	...	1	390
1	1	...	2	4	...	1	3	...	2	2	...	...	...	...	139
2	...	3	4	15	...	...	1	13	4	7	2	...	...	...	596
1	...	...	...	1	...	...	...	7	...	...	...	...	...	...	140
2	...	...	3	5	...	1	2	3	2	6	1	1	...	...	186
...	...	...	1	...	1	...	...	37	...	2	30	...	...	...	157
1	...	...	2	40	5	...	...	1	1	2	2	5	3	1	452
1	...	7	2	11	...	...	1	3	1	13	2	...	...	...	294
...	...	...	13	19	...	2	3	2	2	17	...	...	...	...	393
...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	22
4	1	9	15	92	7	4	6	23	2	34	1	7	1	...	1530
3	0	1	5	8	0	0	0	0	1	5	0	0	0	0	319
19	4	23	61	230	15	9	19	110	17	95	40	13	4	2	4910
8	9	31	18	85	6	8	25	45	10	77	6	1	2	...	2294
2	...	...	2	1	1	...	1	...	1	3	...	1	...	...	112
1	2	1	2	16	5	...	3	6	2	3	5	...	...	...	234
...	...	...	...	4	...	...	1	...	...	...	...	...	...	...	48
11	11	32	22	106	12	8	30	51	13	83	11	2	2	...	2688
30	15	55	83	336	27	17	49	161	30	178	51	15	6	2	7598

Left: Classification by States of Licensed Airplanes, and Engines in Licensed Airplanes as of Jan. 3, 1931

A SUPERFICIAL examination of the table at the left would suggest there still is a very large stock of unsold planes licensed from the factories where they were built, as an impressive number of machines of each of the popular makes are grouped in the state of their original manufacture. The inference could easily be exaggerated, however, for loyalty to home industry is very marked among users of airplanes, and it frequently happens that a surprisingly large number of bonafide sales are made in the immediate neighborhood of the factory. Of course that is partially due to the lack of a national selling organization and to the making of sales directly from the plant where the plane is produced. Judging from an analysis of these tables, there are only four makes of planes that can be said to have attained a really national distribution, with a reasonably good proportionate representation in all parts of the country.

Taking New York, Pennsylvania, Ohio, Illinois, Michigan, Texas, and California, the seven states with the largest registration, the ten leading makes have been listed for each one. Twenty makes of planes got onto at least one of the lists, six of them finding a place among the leaders in but a single state. The Alexander, Stinson, Travel Air, and Waco were among the select ten in every state. The Mono made the grade everywhere except in Texas and New York. The Fairchild and Ryan both qualified in four states, none of the others in more than three.

Some states are included in the sales drive of nearly every manufacturer, while others are allowed to go by default by many of the constructors. Thus, in New York, where almost every builder makes a special effort, there are 24 makes each having over 1 per cent of the total number of licenses. Illinois has 23 meeting the same condition, but in California there are only twenty, in Texas nineteen, and in Michigan eighteen. The differences may appear small, but they are very real and indicative. The small builders located in the northeastern states tend to neglect the Pacific coast and the southwest, while those from the prairie states and the far west may concentrate on New York and Chicago, yet think of Michigan as off the beaten track and overlook its possibilities.

The tendency to concentration of sales in the neighborhood of the factory is less marked than last year, but some notable discrepancies in distribution still appear. It is still true, for example, that the Travel Air holds the largest number of licenses in Kansas, outnumbering the Waco more than five to one in that state, and that the American Eagle, built just outside of Kansas, is second. The Travel Air retains its lead in Oklahoma and in Texas. In Ohio, on the other hand, there are more Wacos than any other three makes combined, and in the neighboring state of Indiana the Waco retains a healthy lead. In Pennsylvania and in Maryland the Fairchild, which includes the KR Challenger that used to be built in Maryland very near the Pennsylvania line, is the leading make, although there are five others that are ahead of it in the national total. In Arkansas and Mississippi the Command-Aire still stands first on the list, and in Colorado and Idaho, the Alexander.

•

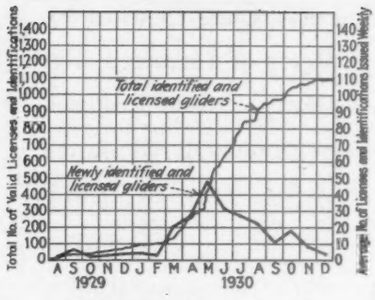
IN the case of the engines, there is less significance to the geographical distribution among the new productions. The choice of the power plant is commonly made by the builder of the airplane, and proximity of the engine factory has relatively little part in his calculations. There are more Kinners licensed in New York than in California, for example, and more Warners in California than in Michigan.

Much more interest attaches to the proportion of war surplus power plants in use in the various parts of the country. Taking the list as a whole, they are obviously on the high road to extinction. When the first statistical number of AVIATION appeared, with its license count based on data of July, 1929, the OX's and the Hispanos and a small number of other wartime types accounted for 59 per cent of all licensed planes. Within six months they had dropped to 44 per cent. During 1930 they have further dropped to 35. The OX-5 and the OXX-6 alone count up 32 per cent, as against 39 per cent at the beginning of 1930. Although this issue is not predominately concerned with phophecy, it seems reasonable to anticipate that by the end of 1932 there will be less than 2,000 licensed machines, or perhaps 2,800 including the identified ones, running on power plants of 1918 design, and that the total number in service will have dropped below a thousand by the end of 1935.

The relative importance of the rôle of the OX and its contemporaries of course varies from place to place. As a general rule, although with some exceptions, the war surplus engines tend to accumulate in the states where great concentration of wealth is unusual, but where flying has become a recognized utility, to be practiced on the best economic terms available. Their best stronghold is in the prairie states, where their proportion of licensed aircraft runs up to over 40 per cent, in Pennsylvania, and along the South Atlantic Coast. In California, New Jersey, and Massachusetts, on the other hand, the OX's account for only about a quarter of all licenses.

AMERICAN glider activity, as shown by the table on page 149, is highly concentrated, five states having almost exactly 60 per cent of the nation's total of gliders. California is in the lead on that score by an even greater margin than on any other item of aeronautical activity, in spite of the fact that there was no plant in California engaged in mass production of primary training gliders. Only in California, Colorado, and Michigan are there as many as one glider for every five airplanes.

Glider production and general activity are mapped by the curves in the next column. They reached a zenith last May, rising rapidly to a peak and falling off almost as rapidly. For the last quarter of the year the average rate of production was less than a third of the average for the second quarter, and the total number of machines in use is at least temporarily stabilized around 1,100. The number of machines reported as newly identified and licensed during 1930 was roughly 980, the glider production of the country being about 40 per cent of the airplane production in number and perhaps three per cent in value.


Total No. of Valid Licenses and Identifications
Average No. of Licenses and Identifications Issued Weekly
Total identified and licensed gliders
Newly identified and licensed gliders
A S O N D J F M A M J J A S O N D
1929
1930

Glider Production, and Gliders in Service

Aircraft Manufacturers Census for United States

Year	No. of establishments	Wage earners (Avg. No.)	Average No. of wage earners per establishment	Wages	Average wage	Paid for contract work	Cost of materials (1)	Value of products	Value added by manufacture (2)
1914	16	168	11	$134,827	803	$12,428	$133,939	$789,872	$655,933
1919	31	3,543	114	4,906,740	1,386	13,645	7,126,965	14,372,643	7,245,678
1921	21	1,395	66	2,202,307	1,580	1,324	2,407,395	6,641,988	4,234,593
1923	33	2,901	88	4,521,949	1,558	149,464	3,829,574	12,945,263	9,115,689
1925	44	2,701	61	4,222,151	1,562	249,540	2,869,967	12,524,719	9,654,752
1927	70	4,422	63	6,857,014	1,553	.....	7,517,183	21,161,853	13,644,670
1929	117	9,856	84	18,804,527	1,910	.....	24,719,846	61,973,079	37,253,233

(1) Including cost of fuel, electric power and shop supplies. (2) Value of products less cost of materials.

Aircraft Personnel Census for United States

Year	[Salaries	[Wages	Distribution of Personnel: Officials	Clerks	Wage earners	Total employees	Ratio of Salaries to wages	Ratio of wage earners to total employees
1914	61,434	134,827	9	45	168	444	0.456	0.378
1919	2,000,690	4,906,740	14	645	3,543	8,404	0.408	0.421
1921	1,033,001	2,202,307	2	555	1,395	1,952	0.469	0.714
1923	1,637,653	4,521,949	8	587	2,901	3,496	0.362	0.830
1925	1,569,198	4,222,151	6	656	2,701	3,363	0.371	0.803
1927	2,289,054	6,857,014	13	1,064	4,422	5,499	0.334	0.804
1929	*	*	*	*	11,079	*	*	*

*Figures for 1929 not available.

IN last year's Statistical Issue, it was possible to make only the most generalized observations about the death-rate among airplanes, as there was nothing with which to compare the analysis of the licensed machines at that time, except the production statistics of the various years. In the tabulation on this page, taken in conjunction with that which appeared on page 570 of last year's number, we have the material for a comparison that has never before been possible.

Take, as a sample case, the history of a group of two- and three-passenger open cockpit machines of moderate price. Selecting half a dozen well-known makes which have been in large production at some time, it appears that at the beginning of 1930, 406 machines of these groups and of 1927 production were in service. At the end of the year, the number had fallen to 318. Of course, some of these machines may have been exported during the year, but others might have been re-imported, and that factor is probably of small consequence. The decrease in the number in service probably errs, if at all, on the low side, as some of the machines for which the year of manufacture was unknown a year ago have since been identified and now appear in the tabulation. Furthermore, some planes may have been merely identified when first built, and transferred to the licensed list during 1930. That again would be a relatively small item. Making due allowance for the probable effects of all such factors, however, it seems that the number of these open-cockpit planes of 1927 manufacture on the active license list has decreased by some 22 to 26 per cent during the past year.

An analysis of exactly the same sort for the same types of airplanes of 1928 manufacture showed the disappearance of about 16 per cent there. For 1929, the figures are much less certain, as a number of machines of 1929 manufacture were first licensed after the tabulation of Jan. 15, 1930, but by a very rough approximation it would appear that only about 6 per cent of the open-cockpit machines of 1929 manufacture went off the list during the past year. Since they could hardly be worn out in so short a time, the 6 per cent must represent the rate of elimination by crash.

Exactly similar studies were made for the cabin machines, excluding the very smallest and cheapest of that class, and for the larger transport types, including the amphibions. Among the considerably more expensive cabin machines the attrition is, as might be expected, less rapid than among the low-priced open cockpit types. They have better care, and perhaps better operation on the average. There are hardly enough 1927 cabin machines still in operation to serve as a basis for calculation, but of the 1928 models only about 10 per cent seem to have gone out of action during the year, together with about 8 per cent of those of 1929. Again the lower figure presumably represents attrition by crash, though it is higher than might be expected.

A similar operation on the transport planes and high-priced amphibions gives the entertaining result that the attrition from all years' production is zero. Transport planes seem to be immortal.

That presumption, encouraging for the operator but discouraging for the manufacturer, receives some support from a table printed on page 151, which shows that a number of mail planes of 1926 manufacture are still in transport service after four years of steady use. On the domestic contract air mail services, in fact, there were more machines of 1926 than of 1930 production in use at the end of the year. Of course the life of the transports has hardly had a fair test as yet, for the 1926 machines were never more than a handful. Most of the planes in service were built in 1928 and 1929 and have had no time to wear out yet, but it is evident that their percentage of attrition is small. Some, of course, in fact disappear from the list, but the number being permanently retired from service is small enough so that it is entirely masked by the various factors of uncertainty already enumerated. Although any estimate would admittedly be very rough and based on insufficient data, a fair guess would seem to be an attrition

rate of 5 per cent a year among the one-year old transports, the same among the two-year old machines, and something between 6 and 10 per cent among the three-year olds. In other words, with a good group of transport airplanes all put into service together as new machines, it seems likely that about 83 per cent would still be operating at the end of three years, whereas the similar percentage would be about 66 for the low-priced open cockpit planes and about 71 for the medium-size cabin machine. At the end of five years, we estimate, although admittedly this is quite vague, that 22 per cent of the open cockpit machines, 40 per cent of the cabin planes, and 60 per cent of the transports would still be going.

By mathematical processes which it is not necessary to explain, it is possible to go on and calculate the average life of a plane from these same data. For the low-priced open cockpit type, the average life corresponding to the figures already given works out at 3.7 years. For the small cabin plane it comes to 4.2 years, and for the transport something between 5 and 7 years.

These figures in themselves require some interpretation. It is very noticeable, for example, that the rate of attrition is most rapid among types of airplanes that are no longer built, or that are equipped with "orphan" engines. The Travel Air and Waco, for example, (those two being taken simply as the types of which the largest numbers are in use) and other machines in similar position have considerably less than the average fatality rate. If the study were limited to the well-established machines supported by good manufacturing and service organizations, the average life would probably be found a little over four years for the open cockpit type and about 4½ to 5 years for the cabin plane.

The data given on the transport planes are also quite misleading unless interpreted, as a very large number of machines of that type have not been in intensive use during 1930, certain companies having found themselves stocked up with equipment beyond their actual demand at the beginning of the year. Although the experience of the past year would indicate an average life of six or seven years, it is probable that where equipment is really used to its full capacity, each machine being flown at least a thousand hours a year, about four years will be all it will stand.

From all this, it is possible to go and calculate the replacement demand for the coming year, and to rest the calculation on a considerably sounder statistical basis than was available at the time when the forecast for 1931 was prepared and published in AVIATION for January. Among the open types, for example, it can be estimated that 6 per cent of those manufactured in 1930, 14 per cent of the 1929 products, and 25 per cent of those of 1928 would normally be replaced during the coming year, with an even higher proportion of machines older than that. Without following the calculation in detail, this leads to an estimated replacement requirement of 850 two- and three-passenger open cockpit machines among the licensed planes. Allowing for the effects of existing inventories, this would probably require an actual production of around 650 to 700. Similar calculations for the medium-size cabin plane (three- to seven-passenger) suggest for that group a most probable replacement demand in 1931, existing inventories taken into account, of 120 planes to maintain operations at their present level. This surprisingly low figure results from almost all the existing cabin planes having been built during the last two years. Very few of them will be worn out in 1931, and any large production of machines of that type will have to be disposed of by finding entirely new users.

Licensed Airplanes by Age and Make

	1915 to 1926, Inclusive	1927	1928	1929	1930	Total	Year of Manufacture Unknown	Total
American Eagle	3	9	83	94	67	256	5	261
Arrow	...	1	3	46	.....	50	1	51
Aristocrat	...	...	2	20	6	28	1	29
Avro-Avian	...	...	8	38	.....	46	2	48
Bellanca	...	...	13	37	17	67	1	68
Bird	1	...	.....	68	43	112	...	112
Boeing	1	30	35	48	10	124	4	128
3 engines	...	...	*6*	*14*	.....	*20*	...	*20*
1 engine	*1*	*30*	*29*	*34*	*10*	*104*	*4*	*108*
Buhl	3	6	8	14	6	37	1	38
Cessna	...	...	8	67	9	84	1	85
Command-Aire	1	...	32	122	18	173	6	179
Consolidated	2	...	3	153	125	283	1	284
Open biplane (Fleet)	*2*	...	*3*	*149*	*111*	*265*	*1*	*266*
Commodore (Fb)	...	...	.....	*3*	*7*	*10*	...	*10*
Fleetster (CM)	...	...	.....	*1*	*7*	*8*	...	*8*
Curtiss[1]	...	...	8	78	.....	86	2	88
Curtiss-Robertson[2]	1	...	76	430	29	536	7	543
Eaglerock	2	69	175	119	49	414	6	420
Fairchild (incl. Chall.)	...	19	134	151	25	329	13	342
Open biplanes	...	*8*	*68*	*108*	*20*	*204*	*7*	*211*
Monoplanes	...	*11*	*66*	*43*	*5*	*125*	*6*	*131*
Fokker	3	5	17	65	14	104	3	107
1 engine	*1*	*5*	*8*	*29*	*8*	*51*	*1*	*52*
3 engines	*2*	...	*9*	*36*	*6*	*53*	*2*	*55*
Ford	...	2	27	72	8	109	2	111
Great Lakes	...	...	.....	62	48	110	3	113
International	....	11	12	1	.....	24	2	26
Keystone Amphibion[3]	...	...	5	18	26	49	2	51
Lincoln	2	15	37	31	19	104	1	105
Lockheed	...	...	17	36	17	70	...	70
Mono Aircraft	...	1	94	103	79	277	1	278
Moth	2	...	4	70	42	118	16	134
New Standard	1	...	3	37	23	64	6	70
Nicholas Beazley	...	...	1	25	23	49	1	50
Pitcairn	2	10	22	35	14	83	2	85
Ryan (incl. Parks)	1	12	78	83	18	192	1	193
Savoia-Marchetti	...	...	.....	9	12	21	...	21
Sikorsky	...	2	6	38	20	66	2	68
1 engine	...	*1*	.....	.....	10	11	*2*	13
2 engines	...	*1*	6	38	10	55	...	55
Spartan	...	...	19	45	19	83	...	83
Stearman	1	4	61	71	27	164	4	168
Stinson	1	12	65	90	207	375	3	378
1 engine, 2-3 places[4]	*1*	*5*	*3*	*6*	*4*	*19*	...	*19*
1 engine, 4 place	...	*2*	*26*	*66*	*190*	*284*	*3*	*287*
1 engine, 6-8 place	...	*5*	*36*	*18*	*5*	*64*	...	*64*
3 engines	...	...	.....	.....	*8*	*8*	...	*8*
Swallow	5	16	47	64	7	139	4	143
Travel Air	10	77	293	423	57	860	10	870
Biplane	*10*	*77*	*288*	*330*	*40*	*745*	*9*	*754*
Monoplane	...	...	*5*	*93*	*17*	*115*	*1*	*116*
Viking[5]	...	...	1	6	11	18	...	18
Waco	31	132	387	312	180	1,042	15	1,057
Miscellaneous	50	20	62	253	279	664	59	723
Total	123	453	1,846	3,434	1,554	7,410	188	7,598

[1]Almost all Fledglings. [2]Almost all Robins. [3]Including Loening. [4]Other seats removed to allow for mail and express. [5]Including Kitty Hawk and Schreck.

Engines Used on Licensed Airplanes of Certain Popular Makes

American Eagle **261**

Biplanes 249
- *OX5* *126*
- *Kinner* *99*
- *OXX6* *8*
- *Hisso* *7*
- *Miscellaneous* *9*

Open monoplanes 9
Closed monoplanes 3

Command-Aire **179**

- *OX5* *107*
- *Curtiss* *33*
- *Warner* *24*
- *Miscellaneous* *15*

Consolidated **284**

Open Biplane (Fleet) 266
- *Kinner* *179*
- *Warner* *81*
- *Miscellaneous* *6*

Commodore (Fb) 10
Fleetster (CM) 8

Curtiss-Robertson **542**

- *OX5* *292*
- *Curtiss* *189*
- *Wright Whirlwinds* *53*
- *Miscellaneous* *8*

Eaglerock **420**

- *OX5* *248*
- *Hisso* *93*
- *Wright Whirlwinds* *34*
- *Kinner* *20*
- *OXX6* *7*
- *Miscellaneous* *18*

Fokker **107**

- *Wasp* *82*
- *Wright Whirlwind* *12*
- *Hornet* *11*
- *Miscellaneous* *2*

Fairchild **342**

Monoplanes 131
- *Wright Whirlwind* *67*
- *Wasp* *62*
- *Hornet* *2*

Biplanes 211
- *OX5* *110*
- *Wright Whirlwind* *46*
- *Kinner* *36*
- *Comet* *7*
- *Warner* *3*
- *Miscellaneous* *9*

Ford **111**

- *Wasp (3)* *72*
- *Wright Whirlwind (3)* *37*
- *Diesel (3)* *1*
- *Bliss Jupiter (1)* *1*

Mono Aircraft **278**

2-place 254
- *Velie* *221*
- *Warner* *21*
- *Miscellaneous* *12*

3 and 4-place 24

Pitcairn **85**

- *Wright Whirlwind* *68*
- *OX5* *11*
- *Miscellaneous* *6*

Ryan (including Parks) **193**

- *Wright Whirlwind* *136*
- *OX5* *37*
- *Hisso* *7*
- *Azelson* *6*
- *Wasp* *5*
- *Miscellaneous* *2*

Stearman **168**

- *Wright Whirlwind* *140*
- *Wasp* *15*
- *Miscellaneous* *13*

Stinson (all monoplanes) **378**

4-place (one engine) 287
- *Lycoming* *175*
- *Wright Whirlwind* *65*
- *Warner* *27*
- *Miscellaneous* *20*

6 to 8-place (one engine) 64
Under 4-place (one engine) 19
Three engines 8

Swallow **143**

- *OX5* *109*
- *Kinner* *12*
- *Wright Whirlwind* *7*
- *Hisso* *5*
- *OXX6* *4*
- *Miscellaneous* *6*

Travel Air **870**

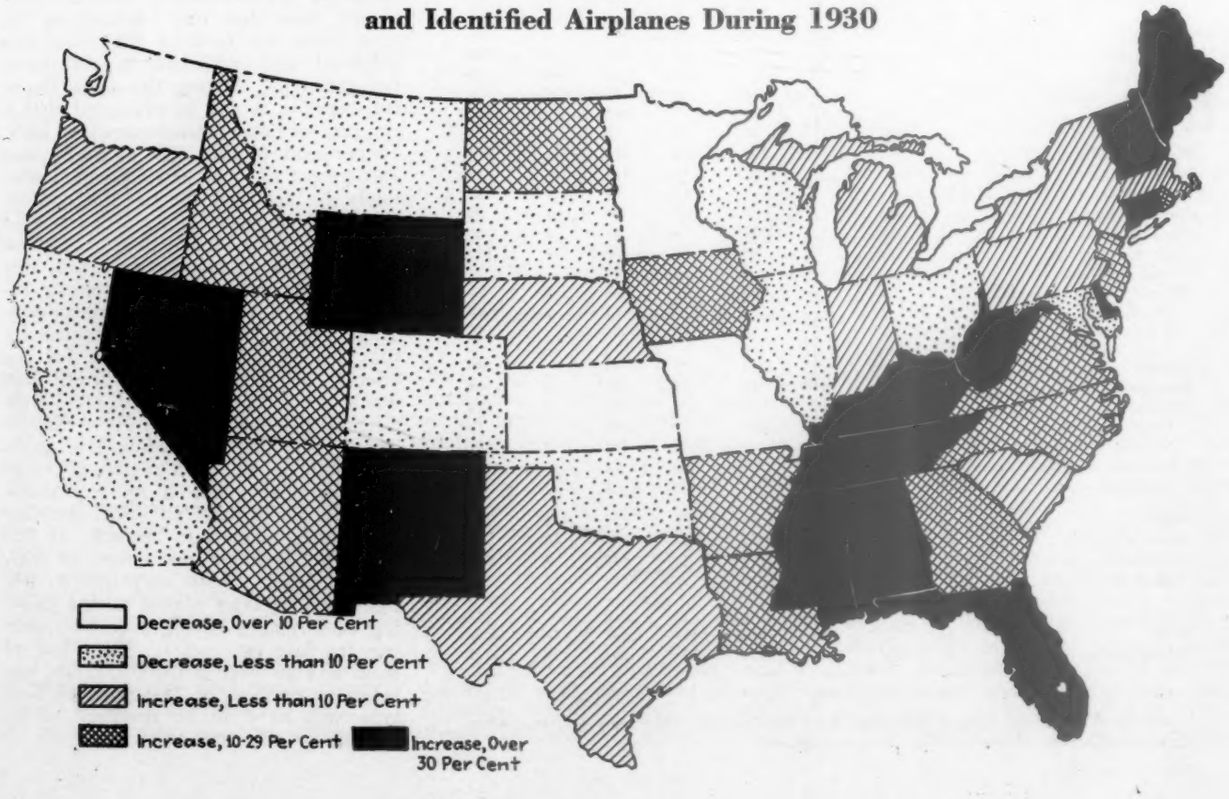
Biplanes 754
- *OX5* *422*
- *Wright Whirlwind* *175*
- *OXX6* *35*
- *Hisso* *33*
- *Warner* *31*
- *Curtiss* *26*
- *Axelson* *10*
- *Kinner* *5*
- *Miscellaneous* *17*

Monoplanes 116

Waco **1057**

- *OX5* *654*
- *Wright Whirlwind* *152*
- *Warner* *110*
- *Hisso* *45*
- *OXX6* *35*
- *Kinner* *32*
- *Siemens Halske* *21*
- *Miscellaneous* *8*

Proportions of Change in Total Numbers of Licensed and Identified Airplanes During 1930


Decrease, Over 10 Per Cent
Decrease, Less than 10 Per Cent
Increase, Less than 10 Per Cent
Increase, 10-29 Per Cent
Increase, Over 30 Per Cent

ALTHOUGH the OX-5 still heads the list of engine equipment for almost all of the open biplanes, its position is considerably less dominant than a year ago. To take as a typical example the make having the largest number of licensed machines in service, at the beginning of 1930, 78 per cent of the Wacos licensed had either OX-5 or OXX6 power plants. At the end of the year, the figure had fallen to 65 per cent. All of the well-known makes except one show a decrease in the total number of licensed planes with wartime engines, and in the one exception to that rule the increase has been less than 1 per cent.

There is a certain tendency toward standardization of engine equipment. Most manufacturers have settled down to one or two engines as established favorites. Where the table shows as much scattering among many different engines as in the case of Travel Air, for instance, it is almost entirely a heritage from the production of past years.

THE map showing the changes of numbers of aircraft in use during the year, like the table which goes with it, includes both licensed and identified machines. It shows a sharply defined tendency to shift the aeronautical center of gravity toward the Eastern states. At the beginning of 1930, California led the country in the number of airplanes in use. New York has now succeeded to the place of honor. The most extraordinary indication of the magnitude and consistency of the change is that of

Aircraft Gliders, Pilots, and Mechanics, as of Jan. 1, 1930

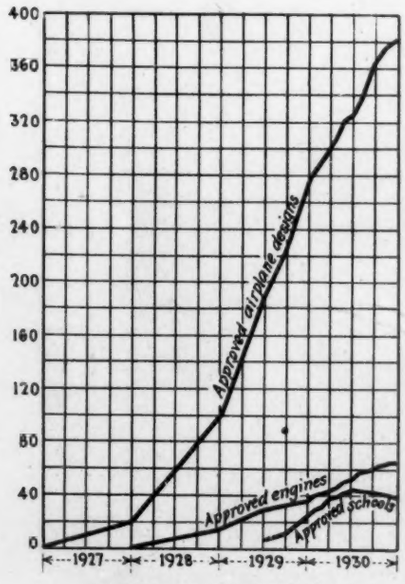
	Aircraft						Pilots					
	Licensed	Unlicensed	Total	Per Cent Licensed	Per Cent Change During Year*	Population per Plane	Gliders	Transport	Ltd. Com.	Industrial	Private	Total	Mechanics
Alabama	23	22	45	0.51	+61	57,170	2	34	3	...	27	64	49
Arizona	30	8	38	.79	+15	12,470	2	18	11	...	54	83	37
Arkansas	51	21	72	.71	+12	26,990	...	33	16	2	71	122	57
California	993	182	1,175	.85	—4	3,860	235	1,010	226	31	1,585	2,852	1,665
Colorado	50	24	74	.68	—4	14,720	97	56	32	...	59	147	76
Connecticut	117	30	147	.80	+37	11,140	8	55	28	1	90	174	129
Delaware	37	12	49	.75	+40	4,980	2		3	...	13	25	16
Dist. Columbia	68	5	73	.93	+18	7,560	10	189	9	...	72	270	144
Florida	86	49	135	.64	+35	10,450	7	51	34	1	110	196	280
Georgia	40	34	74	.54	+12	43,240	1	35	8	...	28	71	44
Idaho	19	7	26	.73	+18	21,010	5	13	8	...	15	36	20
Illinois	475	192	667	.71	—4	11,070	69	335	134	10	452	931	553
Indiana	157	88	245	.64	+1	12,960	30	119	47	1	158	325	144
Iowa	123	53	176	.70	+11	13,790	13	86	49	...	130	265	139
Kansas	170	142	312	.54	—20	5,880	50	126	40	2	105	273	190
Kentucky	46	19	65	.71	+71	39,470	1	38	18	...	35	91	42
Louisiana	86	15	101	.85	+13	19,310	1	37	12	1	41	91	63
Maine	29	17	46	.63	+171	17,270	1	24	9	...	34	67	21
Maryland	76	20	96	.79	—1	16,840	9	50	27	1	80	158	112
Massachusetts	196	44	240	.82	+1	17,890	24	144	56	2	254	456	206
Michigan	361	114	475	.76	0	9,650	117	276	91	3	362	732	447
Minnesota	110	7	117	.94	—39	23,270	13	100	49	1	117	267	132
Mississippi	31	10	41	.76	+78	43,720	1	16	6	1	33	56	16
Missouri	274	91	365	.75	—36	9,650	8	221	77	4	188	490	272
Montana	43	27	70	.61	—5	7,840	...	23	14	...	38	75	51
Nebraska	153	93	246	.62	+2	5,720	7	74	23	...	118	215	120
Nevada	10	1	11	.91	+38	7,040	2	3	2	1	7	13	18
New Hampshire	23	5	28	.82	+47	16,430	4	12	11	...	31	54	19
New Jersey	198	103	301	.66	+19	12,690	35	125	47	2	230	404	301
New Mexico	18	6	24	.75	+33	16,500	2	14	7	...	26	47	14
New York	1,002	191	1,193	.84	0	9,675	104	521	204	11	905	1,641	879
North Carolina	55	38	93	.59	+29	31,560	4	26	18	...	42	86	45
North Dakota	39	34	73	.53	+24	8,775	2	27	9	...	28	64	26
Ohio	408	174	582	.71	—6	11,730	94	309	134	...	359	802	511
Oklahoma	238	88	326	.73	—3	7,435	6	185	57	4	144	390	156
Oregon	68	51	119	.57	+1	7,540	8	76	27	...	77	180	106
Pennsylvania	410	88	498	.82	+8	19,775	37	216	132	8	454	810	401
Rhode Island	33	7	40	.83	+18	17,900	1	11	7	...	34	52	20
South Carolina	13	26	39	.33	+5	47,800	2	23	7	...	16	46	18
South Dakota	53	16	69	.77	—4	10,210	9	41	19	1	51	112	46
Tennessee	82	35	117	.70	—38	21,380	6	60	22	...	61	143	70
Texas	340	96	436	.78	+1	12,580	16	384	60	7	281	732	402
Utah	27	13	40	.67	+29	13,275	3	51	4	...	21	76	62
Vermont	16	3	19	.84	+46	18,520	1	12	9	...	7	28	10
Virginia	50	18	68	.74	+11	37,840	6	129	21	1	44	195	270
Washington	148	42	190	.78	—15	8,360	8	117	53	1	124	295	184
West Virginia	32	11	43	.74	+39	40,110	3	20	17	...	32	69	25
Wisconsin	176	73	249	.71	—7	11,860	19	104	49	1	131	285	99
Wyoming	48	9	57	.84	+216	4,330	3	17	3	...	16	36	63
Alaska	14	5	19	.74	+58	2,890	...	5	4	...	6	15	15
C. Z	...	2	2	...	....	.....	...	42	1	...	1	44	68
T. H	6	1	7	...	....	.....	...	37	1	...	9	47	98
Miscellaneous	3	2	5	...	....	.....	...	53	2	...	27	82	42
Total	7,354	2,464	9,818	...	....	.....	1,088	5,792	1,957	98	7,433	15,280	8,993

*Based on total licensed and identified planes.

the 24 states east of the Mississippi only one showed a decrease in the number of planes in use, while of the 24 Western states, nine have decreases to record. Ten of the Eastern group show increases of over 30 per cent in their numbers of planes, and only three in the western part of the country have made as much relative progress.

Examining the map in more detail, it is evident that there are solid and sharply defined areas of increased aeronautical activity in New England and in the regions immediately south of the Ohio and east of the Mississippi rivers. The area having suffered the greatest losses, on the other hand, is almost coincident in its boundaries with the wheat and corn belts, the only really bright spots in that region being Iowa and North Dakota. There are several possible explanations. The most obvious is, of course, the general distress over the falling price of grain and over the failure of governmental farm relief to accomplish as much as had been hoped. The great drouth comes immediately to mind, yet Southern states even more seriously affected by the drouth show a good increase in the number of planes in use. No doubt an important factor has been the availability of innumerable natural landing fields in the wheat belt. Because of good flying conditions, aviation was accepted there as a commercial utility more rapidly and more easily than anywhere else in the country. In New England and in the South-East the process was slower, and there has been relatively more room for recent progress. Extending the same line of reasoning, it would seem that the Atlantic Coast States from Massachusetts down to Georgia offer favorable opportunities for coming years.

Before leaving the map, it should be noted that in two or three cases the figures for a state are distorted by the location there of factories which had a large inventory on hand at the beginning of the year, and which cleared it up or moved it to an address in another state during the year. The most notable examples are Massachusetts, Kansas, and Missouri, which are therefore credited with figures less favorable than they really deserve.



A.T.C.'s in Force, and School Approvals

For the first time, the number of private pilots is in excess of the number holding transport licenses. During the past year the former figure has increased by 79 per cent; the latter by only 28.

Geographical differences in the proportion between the transport and private certificates are likely to be more apparent than real. Thus, in the District of Columbia the transport licenses outnumber the private ones more than two to one largely because of the great number of military and naval pilots who have their permanent addresses in Washington and who hold transport certificates. Aside from such causes, the proportion of the transport class is of course highest in the states where important airlines are located and where there is but little sport flying. Wyoming is a case in point. In Massachusetts or New York, on the other hand, there is an exceptionally large amount of flying by private owners and the proportion of private licenses is accordingly high.

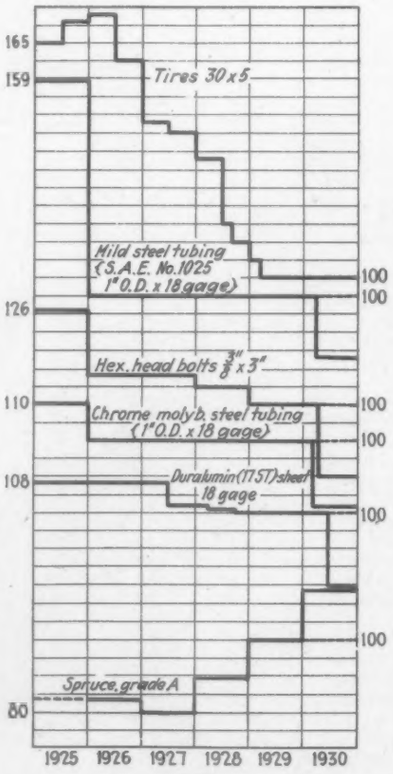
In the total figure of licenses California continues to lead the country, but with some assistance from military and naval pilots residing at San Diego. Even with that factor eliminated, however, the California total would undoubtedly exceed that for the next two states combined.

MATERIALS

We have again followed the practice of indicating the general trend of prices on certain raw materials and parts important in the fabrication of aircraft without giving absolute figures in dollars and cents. The results are plotted herewith. A number of manufacturers were willing to furnish actual prices for use in making up a trend chart, but did not wish that the actual wholesale prices be published. All the curves have been plotted in terms of percentage changes, taking the price at the end of 1929 as the base. Each vertical division on the chart represents five per cent of the present price, and the curves have been spread out arbitrarily to avoid confusion and overlapping. The prices at the beginning of 1925, on a scale of 100 for the price level five years later, are marked in at the left-hand end of each curve. For the data upon which the curves are based we are indebted to the Summerill Tubing Company, the Aluminum Company of America, the Aero Supply Manufacturing Company, the Goodyear Tire & Rubber Company, and the U. S. Rubber Company. The price range of spruce was determined by averaging the prices paid by several airplane manufacturers who made their records available.

The specific article upon which prices were requested is defined upon the curve in each instance. Sizes and gages of extensive aeronautical use were selected, and the prices sought were those which would have to be paid by a manufacturer of airplanes buying in large quantities.

Following the general wholesale price level on commodities, the prices of aeronautical raw materials have dropped sharply during the past year. The drop has been almost uniform in amount, mild and alloy steel tubing and duralumin all having gone down between 8 and 10 per cent since the beginning of 1930. The price of spruce, on the other hand, rose nearly 15 per cent, following the tendency of the past four years and portraying the gradual depletion of readily available timber resources. Among fabricated parts, hardware shows a drop of the same order, while airplane tires have undergone no price change during the year.



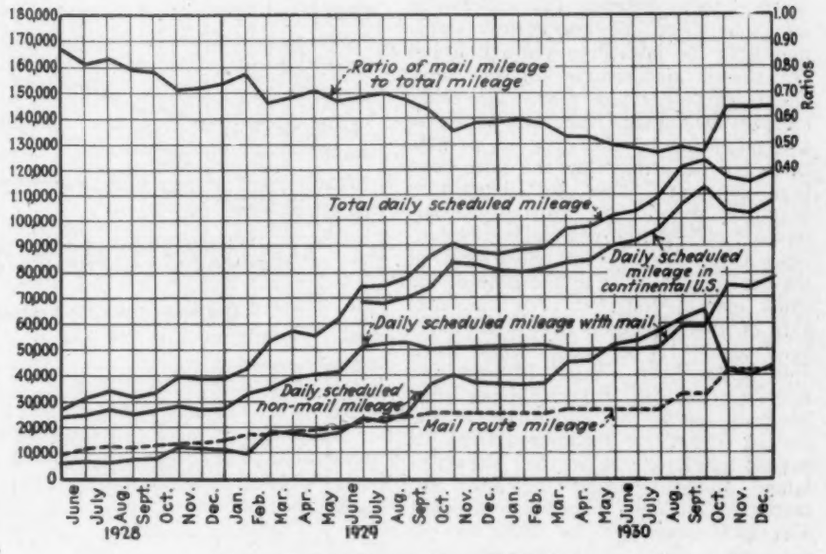
Variations in Relative Price Levels on Materials

U. S. AIR MAIL AND PASSENGER TRANSPORT

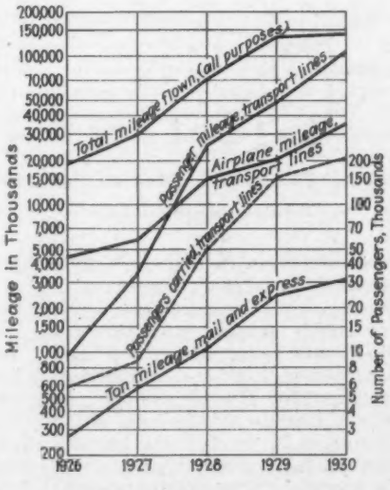
THE principal feature of the monthly scheduled - mileage curves over the last year has been a reversal of the previous trend in the distribution between mail and non-mail operations. Up through the summer of 1929 the contract mail operations dominated the field so completely that they accounted for more than 80 per cent of the mileage flown daily. As the first effects of large-scale financing began to be felt, and as enthusiasm for passenger operation grew, the ratio dropped quite steadily to 0.70 in the late winter of 1928, to 0.60 in the fall of 1929, and to below one-half in the late spring of 1930. As the Watres Act took effect, and as contracts were given to certain of the established passenger operators, the curve of the ratio turned sharply upward. At the end of the year the scheduled non-mail mileage was almost on a level with that of 14 months previously, but the mileage with mail had increased more than 30 per cent in the same time.

Total scheduled mileage has shown its usual tendency to relapse with the coming of the winter months. The high for the year is always reached in September or October. The total daily schedule for all transport services is 37 per cent higher than at the end of the year 1929.

All of the curves except one include the mileage on all lines under American control, even those which run so far afield as Chile and Argentine. For the first time, we have determined and present in this chart values for the daily mileage scheduled within the continental United States. This is not equal to the Department of Commerce figure for domestic routes, since that excludes the entire length of all routes which have any part of their extent in foreign countries. In plotting our curve of home mileage we have included those sections of foreign air mail and passenger lines which lie within the territory or territorial waters of the United States, excluding Alaska and all overseas possessions.



Transport Mileage, Month by Month



Transport Operations and Total Flying, Year by Year

THE passenger mileage on American transport lines has been increasing at a perfectly fantastic rate over the past four years. Only in 1929 did it fail to double the previous year's figure, and then it fell only very slightly short of doing so. Neither airplane mileage nor the number of passengers carried has gone up as rapidly, for both the average number of paying passengers carried per transport plane and the average length of journey have been increasing.

Ton mileage of mail and express has been multiplied by eleven in the four-year period in which passenger mileage was multiplied by 110. Measuring by volume of traffic and not by receipts, the business of American air lines was roughly 26 per cent passenger in 1926, 70 per cent in 1928, and 77 per cent in 1930.

Air mail contracts, however, still account for about 75 per cent of the total revenue. Very roughly, the gross income per ton-mile handled for 1930 averaged 70 cents on passenger business and $5 on air mail. Under the Watres Act, the rate of income on domestic mail can hardly average over $3 a ton-mile.

The total mileage flown for all purposes can of course be only very roughly determined. The figures plotted are those of the Department of Commerce, and show an 80 per cent increase in 1929, 10 per cent in 1930.

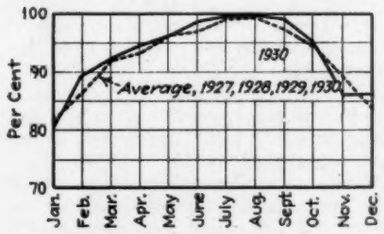
Planes in Use by Transport Operators

(See comment in this issue)

	Year of Manufacture					
	1926	1927	1928	1929	1930	Total
Multi-engine transport	0	2	29	86	12	129
Single engined cabin	1	38	51	73	10	173
Mailplanes	18	9	57	59	3	146
Flying boats and amphibions	0	0	6	33	3	42
Total	19	49	143	251	28	490

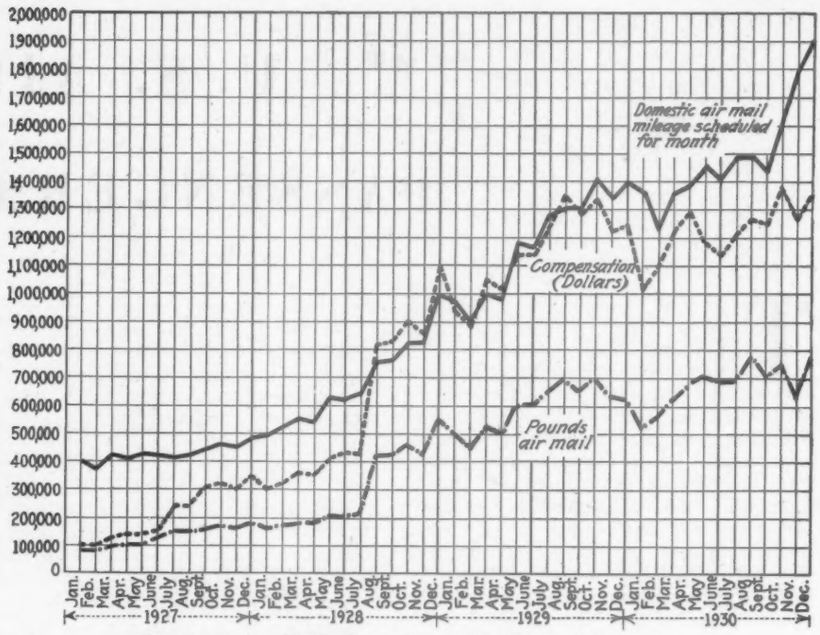
AIR mail mileage and poundage figures continue to show steady progress. Irregularities in the mileage curve can be accounted for by the length of the month, and if February, April, June and September were all adjusted to the length of 31 days the curve would be almost perfectly smooth. The poundage of mail continues on the whole to move up steadliy, with a little decrease in November each year on account of the decreased reliability of service in winter, and with a sharp drop in January after the Christmas mail. The results are better shown in the seasonal curve, whence there appears the astonishing fact that there has not been a single month in the last three years that has not shown an increase for the same month in the previous year. The sharp increase in August, 1928, was of course accounted for by the drop in postage rates, but since that time the rates have been constant. The rate of gain is gradually decreasing. During the latter part of 1929 the poundage was running about 50 per cent above that of the previous year up to the time of the stock market collapse. For the first half of 1930 the gain over 1929 averaged about 15 per cent, while since July it has been around 10 per cent. Even a growth of 10 per cent per year, however, would be far ahead of the normal growth of business activity in normal times, and the air mail has maintained that rate under the most unfavorable business conditions possible. The total poundage for 1930 on the domestic routes was 14 per cent above that for 1929. Total payments to contractors increased 7 per cent.

November came near breaking the three-year record of invariable monthly increase over the preceding year, unusually bad flying weather being partly responsible. Business came back splendidly with the end of the year, however, and the Christmas mail brought the December figure almost up to the record month of August.

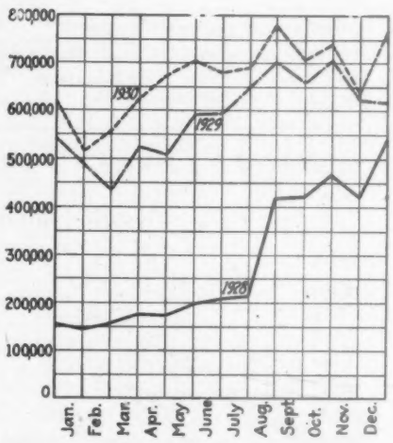


Percentage of Scheduled Mileage Flown on Domestic Mail Routes

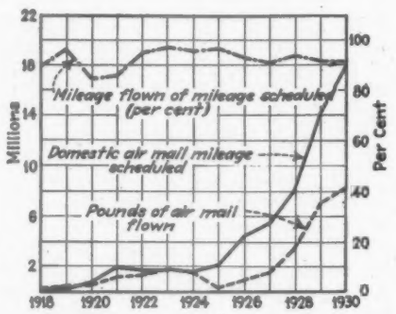
THE curve of regularity of air mail service, as shown by the ratio of mileage flown to mileage scheduled, has been somewhat smoother than in 1929, at least up to within the last month of the year. The percentage of regularity, after having been maintained around 95 for several years under government operation, began to fall off in 1926 and fell still further, as low as 91 per cent, in 1927. The drop was to be accounted for principally by the introduction of contract air mail and the rapid expansion of the service, especially of night flying, with the necessary introduction of some inexperienced personnel. In 1928 the curve turned up again, but dropped in 1929 due to abnormally bad weather for several months. Nineteen thirty roughly held its own with one bad month in November, but keeping above the average of the three years previous in most of the remaining months. The average performance in 1930 would have been considerably better than it actually was were it not for the opening of several new routes intended primarily for passenger transport and handling air mail as a side line. Necessarily accommodating themselves to the convenience and safety of passengers as the first consideration, they have found it difficult to maintain as high an average of regularity as mail lines which carry no passengers at all or which allow the pilot to leave the passengers off in case of bad weather while he goes on with the air mail and a parachute.



Domestic Air Mail, Operations, Traffic, and Income



Total Poundage of Mail on Domestic Routes, Seasonal Curves



Thirteen Years of Air Mail

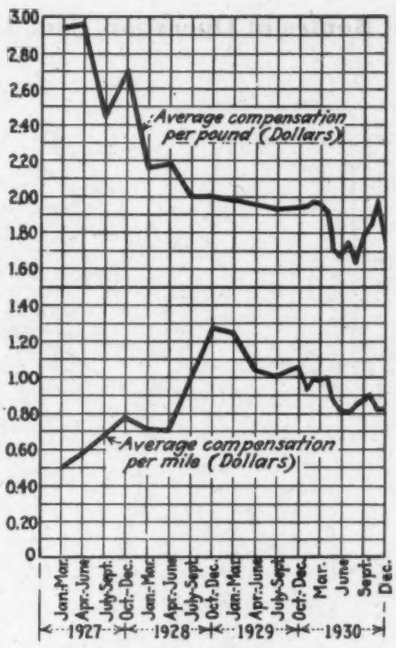
Adjustments of the air mail map, as shown on page 154, are tending either to eliminate the routes in which the public has shown least interest or to stimulate the patronage that they receive. The number of contract routes averaging less than 100 lb. of mail per scheduled trip during 1930 was only six, as against nine in the previous year.

Although the percentage of scheduled mileage flown is determined principally by average weather conditions and terrain (it is much easier, for example, to make a higher score in Arizona or Texas than across Pennsylvania), the table shows some very notable records made even under under extremely difficult flying conditions. A conspicuous example, although not the only one that might be cited, is the service along the Pacific Coast from Seattle to San Diego. In spite of the very mountainous nature of the country and the frequency of poor visibility over part of the northern section of the route, the percentage of scheduled mileage flown was 96.9 last year and even a shade higher than that in 1929. Only one or two other routes have so persistently maintained so high a figure.

THE principal cause of change in the table (below) of mail carried and compensation on individual routes has of course been the Watres Act, which has moved toward an equalization of the rate of compensation among the various lines.

For 1930 not a single contractor received over $1.80 per mile flown, while in 1929 the payment exceeded that figure on four routes. On six of the twenty-seven domestic routes the average payment during the past year was between 85 cents and $1.10 per mile, as against only two lines within those limits for the previous year. As the conversion to the Watres act scale of payment was in many cases made only rather late in the year, it did not have a chance to show its full effect. For 1931, if there is no further change in law or regulation, most of the contract services will probably be within the limits just specified.

Although sixteen of the 24 routes which existed throughout the two years showed an increase of poundage over 1929, the percentage of increase varies largely. The heaviest losers on poundage were among the operators of short feeder routes, for the rearrangement of schedules and the introduction of the new trans-continental services is giving new mail outlets to some of the cities that were heretofore dependent solely on the feeder lines for their service.



Air Mail Compensation

THE average compensation to the contractor per pound of mail carried is, since the passage of the Watres bill, of indirect and limited interest, as the distances over which the mail must be transported vary so widely. The average compensation per mile continues to be a very critical factor in determining the financial prospects of the contracting company.

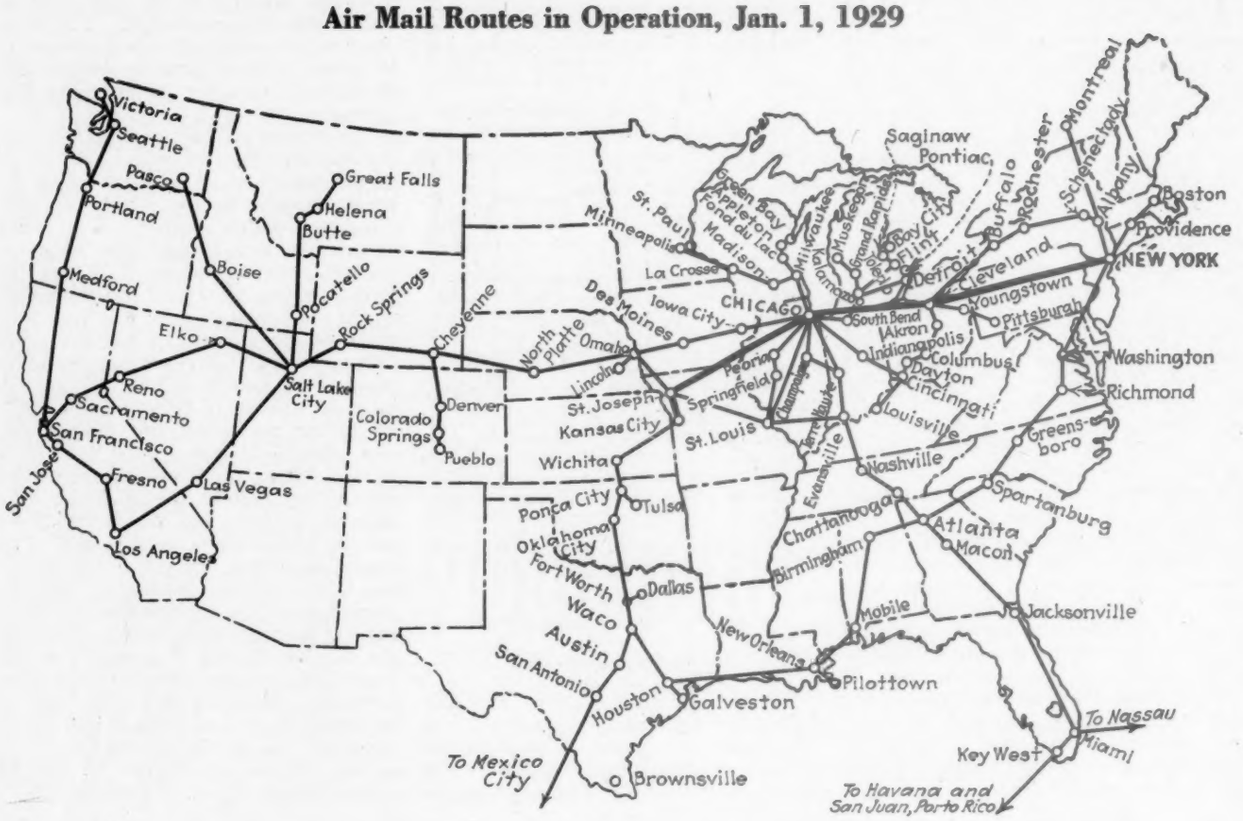
The income per mile rose sharply during the latter part of 1928 as the result of the decreased air mail rates and the great increase in the weight of mail dispatched which resulted. Ever since then it has, in a general way, been declining. The decline of 1929 was due to the opening of several new routes on which the poundage rate was very low, and over which but little mail was sent. Comparative stability was reached at an average of almost exactly $1 a mile from the summer of 1929 through April, 1930. At that point the Watres Act took effect. It was applied first on a group of lines for which contracts had been let in 1926 at the maximum rate allowed by law, and which had been making an extremely good return. The immediate effect, therefore, was to decrease the average income per mile by cutting down the high returns and leaving the low ones undisturbed. Later in the summer the act was applied to the lines that had been running under most favorable conditions previously, and it increased their compensation and so the average. The tendency now seems to be to stabilize at between 80 and 90 cents per mile flown on the average.

Mail Carried by Routes for 1930

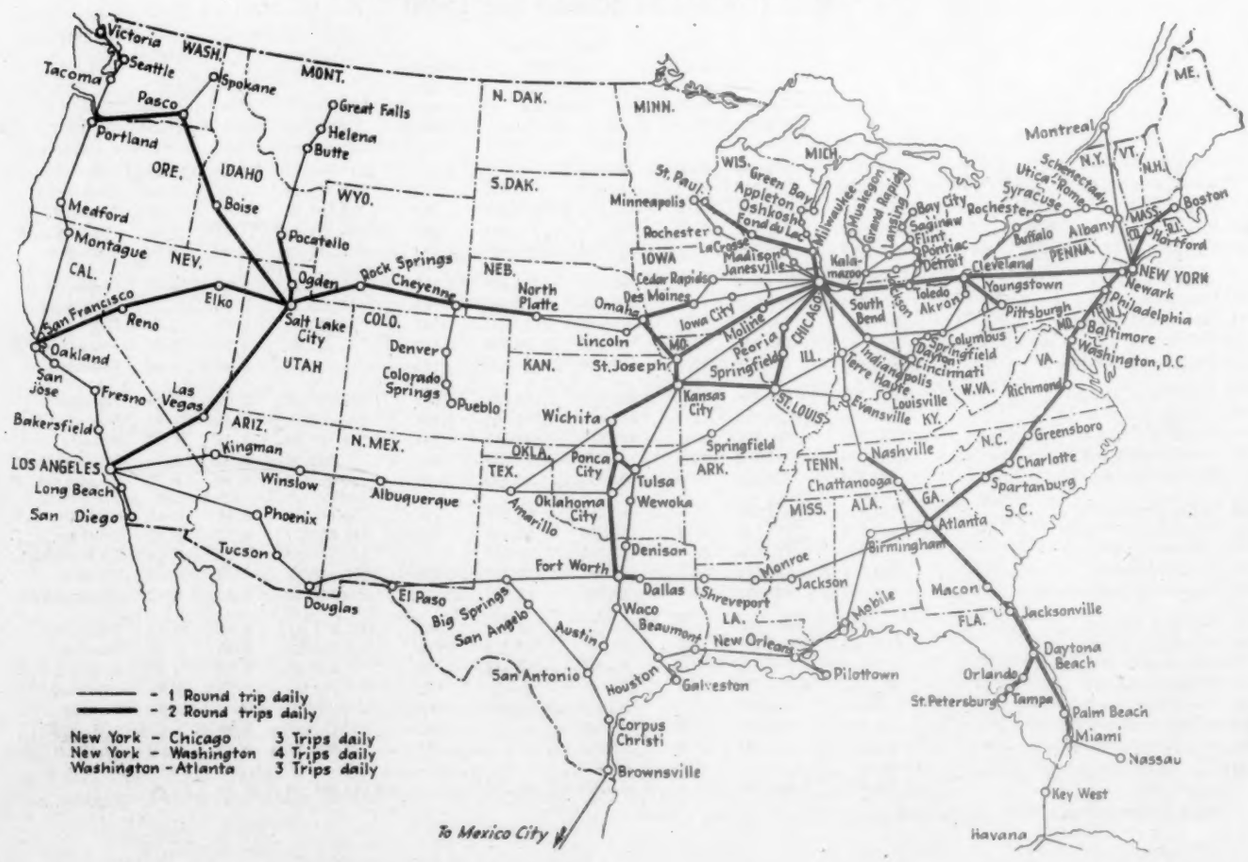
Route	Miles of Service — Scheduled	Miles of Service — Actually Flown	Per Cent of Scheduled Mileage Flown	Total Weight of Mail Dispatched (Pounds) — 1930	Total Weight of Mail Dispatched (Pounds) — 1929	Average Weight per Scheduled Trip	Amount Paid to Contractor	Average Compensation per Mile Flown — 1930	Average Compensation per Mile Flown — 1929	Contractor
1. Boston-New York	197,013	178,540	90.6	120,582	116,095	215	$221,444.72	$1.24	$2.95	Colonial
2. Chicago-St. Louis	413,920	373,847	90.4	61,370	78,077	42	208,219.58	0.56	0.62	Universal
3. Chicago-Dallas	1,496,989	1,358,777	90.7	436,046	391,407	299	1,198,699.40	0.91	1.01	National
4. Salt Lake City-San Diego	968,641	927,893	95.7	857,724	757,685	825	1,589,284.22	1.71	3.17	Western A. E
5. Salt Lake City-Seattle	1,039,077	970,498	93.1	284,535	236,083	261	894,515.16	0.92	1.52	Varney
8. Seattle-San Diego	836,102	811,119	96.9	288,447	253,437	395	715,544.21	0.88	0.95	Pacific Air T.
9. Chicago-St. Paul	1,027,596	985,560	95.8	225,104	179,376	103	650,253.69	0.66	0.71	Northwest
11. Cleveland-Pittsburgh	207,939	190,917	91.8	65,067	97,027	45	172,138.31	0.90	2.07	Ball
12. Cheyenne-Pueblo	151,338	141,704	93.6	89,399	98,828	122	81,105.46	0.57	0.54	Western Air E.
16. Cleveland-Louisville	271,874	248,329	91.3	79,548	95,840	109	113,333.51	0.46	0.48	Universal
17. New York-Chicago	1,429,272	1,269,400	88.7	1,693,253	1,618,287	1,084	1,378,357.59	1.09	1.14	National
18. Chicago-San Francisco	2,812,181	2,679,852	95.3	2,075,609	1,797,506	1,501	3,786,107.99	1.40	1.41	Boeing
19. New York-Atlanta	1,182,274	1,066,496	90.2	461,918	341,590	344	1,348,182.30	1.26	1.83	Pitcairn
20. Albany-Cleveland	285,743	258,792	90.3	64,274	103,083	103	92,517.37	0.36	0.36	Colonial West
21. Dallas-Galveston	234,834	220,676	93.9	36,410	45,394	50	107,002.13	0.49	0.57	Southern A. T.
22. Dallas-Brownsville	388,334	374,392	96.4	88,259	83,671	121	256,141.59	0.68	0.66	Southern A. T.
23. Atlanta-New Orleans	353,142	339,834	96.2	109,906	86,610	151	197,772.12	0.58	0.47	Southern A. T.
24. Chicago-Cincinnati	410,261	359,576	87.6	77,210	79,364	53	122,175.58	0.34	0.34	Embry-Riddle
25. Atlanta-Miami	560,351	528,343	94.8	188,202	121,333	258	276,602.98	0.52	0.39	Pitcairn
26. Great Falls-Salt Lake City	497,580	487,901	98.1	63,503	69,373	87	223,597.66	0.46	0.42	National Park
27. Bay City-Chicago	661,530	601,170	90.9	184,779	173,232	302	287,015.11	0.48	0.33	Thompson
28. St. Louis-Omaha	592,164	566,460	95.7	181,671	65,279	125	142,550.04	0.25	0.21	Universal
29. New Orleans-Houston	233,429	232,522	99.6	52,461	42,146	72	52,449.47	0.23	0.21	Southern A. T
30. Chicago-Atlanta	688,016	624,872	90.8	123,968	98,067	170	125,793.64	0.20	0.15	Interstate
32. Pasco-Seattle (a)	189,416	176,253	93.1	83,028	52,909	229	7,472.57	0.04	0.05	Varney
33. Atlanta-Los Angeles*	375,180	326,258	87.0	44,169	.....	282	293,212.91	0.90	.....	S. A. F. E.
34. New York-Los Angeles*	456,299	361,293	79.1	48,761	.....	358	140,904.27	0.39	.....	Trans. & West
Total	17,960,495	16,661,274	92.6	8,085,203	7,100,027	.....	$14,682,393.58	$0.88	$1.06	

*Established October, 1930. (a) Consolidated with C.A.M. 5, July 1, 1930.

Air Mail Routes in Operation, Jan. 1, 1929



Air Mail Routes in Operation, Jan. 1, 1931


Victoria
WASH.
Seattle
Tacoma
Spokane
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Pasco
Portland
ORE.
IDAHO
Great Falls
Helena
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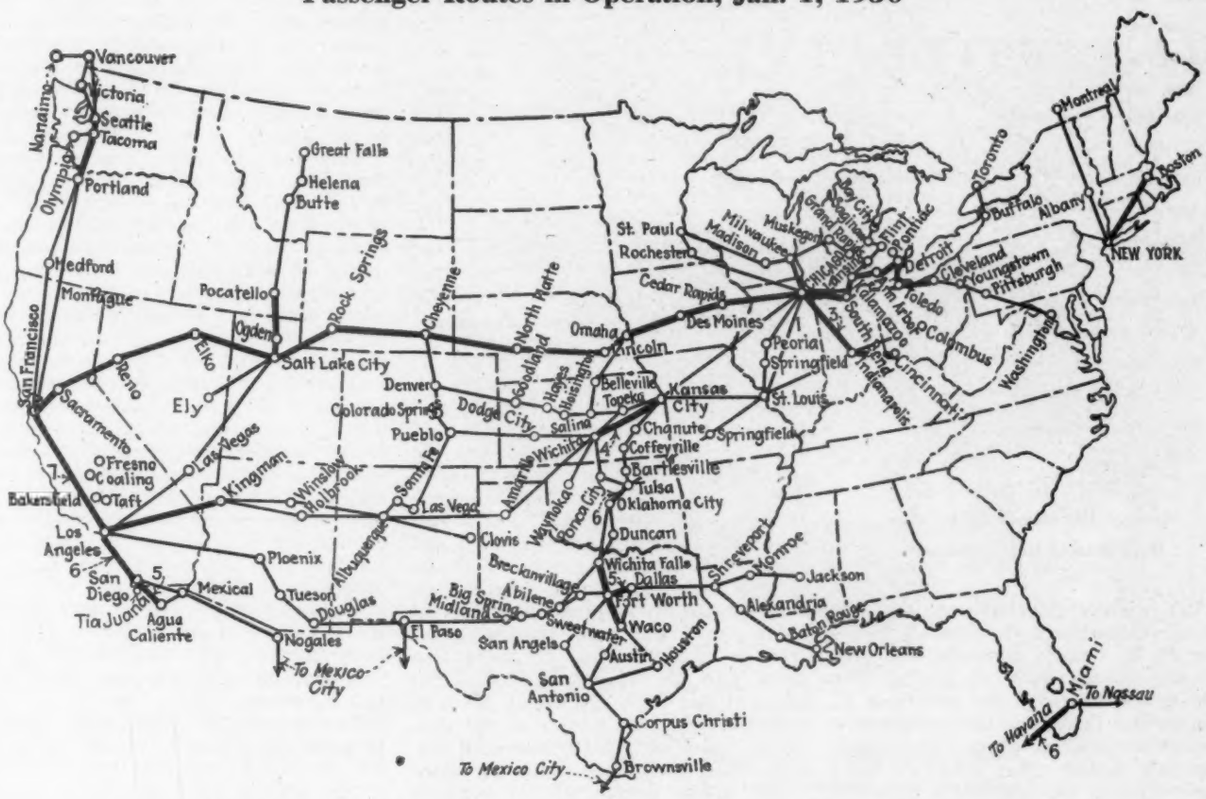
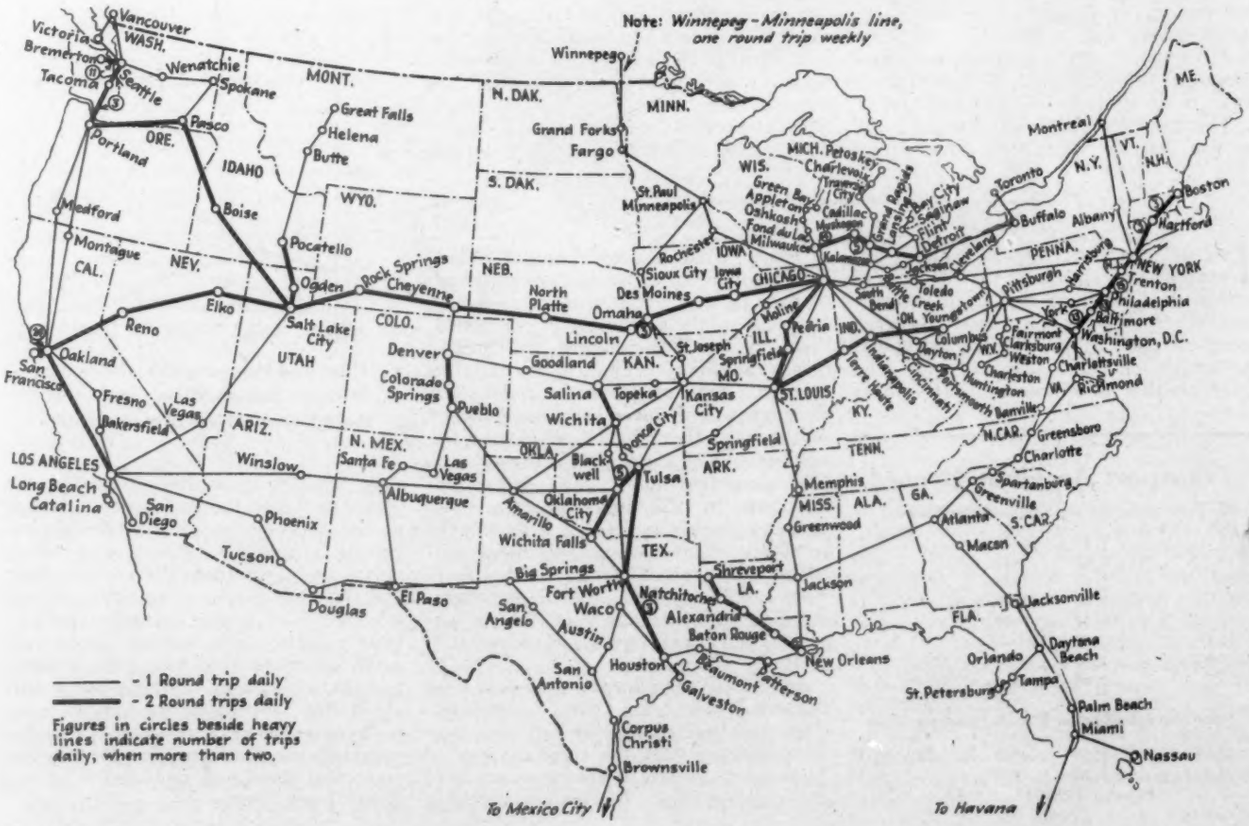
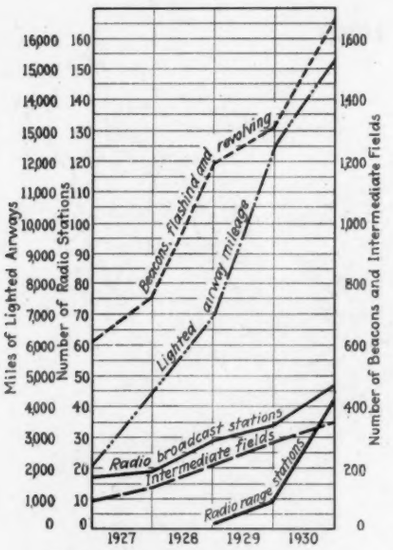
MINN.
S.DAK.
WYO.
Medford
Boise
Pocatello
Montague
NEV.
CAL.
Ogden
Rock Springs
Cheyenne
NEB.
North Platte
Omaha
San Francisco
Reno
Elko
Salt Lake City
COLO.
Denver
Lincoln
Oakland
San Jose
Fresno
Las Vegas
UTAH
Colorado Springs
Pueblo
KAN.
St. Joseph
Bakersfield
ARIZ.
Kingman
N. MEX.
Wichita
Kansas City
LOS ANGELES
Long Beach
San Diego
Winslow
Albuquerque
OKLA.
Ponca City
Tulsa
Wewoka
TEX.
Oklahoma City
Amarillo
Phoenix
Tucson
Douglas
Fort Worth
Denison
Dallas
El Paso
Big Springs
San Angelo
Waco
Austin
Beaumont
San Antonio
Houston
Galveston
Corpus Christi
Brownsville
To Mexico City
Pilottown
New Orleans
Monroe
Shreveport
Jackson
LA.
ARK.
Springfield
Nashville
TENN.
Chattanooga
MISS.
ALA.
Birmingham
Atlanta
GA.
S.C.
N.C.
Greensboro
Charlotte
Spartanburg
Macon
Mobile
FLA.
Jacksonville
Daytona Beach
Orlando
St. Petersburg
Tampa
Palm Beach
Miami
Nassau
Key West
Havana
WIS.
MICH.
Green Bay
Appleton
Oshkosh
Fond du Lac
Milwaukee
Muskegon
Grand Rapids
Lansing
Bay City
Flint
Saginaw
Pontiac
Detroit
Minneapolis
St. Paul
Rochester
IOWA
LaCrosse
Madison
Janesville
Kala-mazoo
Cedar Rapids
Des Moines
Iowa City
Moline
CHICAGO
South Bend
Gary
Toledo
Akron
Cleveland
Youngstown
Pittsburgh
Buffalo
Albany
Schenectady
Utica
Syracuse
Rochester
Montreal
ME.
N.Y.
VT.
N.H.
MASS.
R.I.
Boston
Hartford
PENNA.
NEW YORK
Newark
N.J.
Philadelphia
MD.
Baltimore
Washington, D.C
VA.
Richmond
W.VA.
Louisville
KY.
Evansville
ILL.
Peoria
Springfield
Terre Haute
Indianapolis
Cincinnati
Columbus
Dayton
Springfield
Missouri
Kansas City
St. Louis
Wichita
Ponca City
Tulsa
Wewoka
Oklahoma City
Amarillo
Denison
Fort Worth
Dallas
Waco
Beaumont
Austin
San Angelo
Big Springs
El Paso
Douglas
Tucson
Phoenix
Winslow
Albuquerque
Kingman
Bakersfield
LOS ANGELES
Long Beach
San Diego
Oakland
San Jose
Fresno
Las Vegas
Reno
Elko
San Francisco
Salt Lake City
Ogden
Rock Springs
Cheyenne
Pocatello
Boise
Medford
Montague
Portland
Pasco
Seattle
Tacoma
Spokane
Great Falls
Helena
Butte
Lincoln
Omaha
North Platte
Des Moines
Iowa City
Moline

Passenger Routes in Operation, Jan. 1, 1930



Passenger Routes in Operation, Jan. 1, 1931



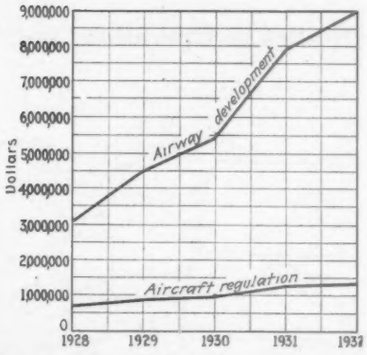


Airway Development by the Department of Commerce

THE airway development work of the Department of Commerce has gone on at a fairly constant rate over the last three years, so far as the lighting of airways, the provision of intermediate fields, and the development of communication facilities is concerned. The only activity that shows a rapid acceleration is the installation of radio-range stations, of which there were hardly any at the beginning of 1929.

The normal rate of progress has been to lay off about 3,600 mi. of lighted airway per year and erect about 300 beacons during the same period. Radio stations go up at the rate of about ten, intermediate fields at about 70, per year. A continuation of the present rate would complete the lighting of all domestic air mail route mileage within four years.

The curves show clearly the tendency to use beacons of higher power than in the first years of airway lighting, and to space them farther apart. Although in recent years there has been only one new beacon for every twelve miles of new airway, in 1927 there was a beacon operating for every three and a half miles, a ratio that had changed to six miles per beacon at the end of 1928 and to nine miles at present. Intermediate fields, practically all of which are on the lighted airways, have changed their average spacing from 21 miles four years ago to 44 miles now. The necessity for the intermediate fields of course becomes less marked as the number of municipal and commercial airports along recognized routes increases.



Department of Commerce Appropriations—Fiscal Years

The appropriations for the work of the Department of Commerce, as shown by the chart in the second column, are directed more and more largely to airway devolopment. Though it is the work of regulation that brings the Department most often into direct contact with the aircraft industry, 87 per cent of the total funds provided to the Aeronautics Branch in the appropriation for the fiscal year 1932 will go into building and maintaining airways. The proportion has never been below 80 per cent since the work was started.

INNUMERABLE devices have been invented for showing the degree of safety or hazard of travel in aircraft and other vehicles, but from the very practical point of view of the individual passenger or pilot there is only one question that is of interest. He wants to know what chance there is of his being injured or killed in a given length of time or in a given amount of flying.

So far as the passenger is concerned, there is only one figure that really means anything. That is the fatality rate in terms of passenger-miles. In the curve in the lower right-hand corner of the page there has been plotted the number of passenger fatalities per million passenger-miles. It reached its maximum in 1928, and since then it has dropped sharply in 1929, a little further in 1930. However, as observed editorially on page 126, if the period from Feb. 1, 1930, to Feb. 1, 1931, be substituted for the calendar year, the passenger fatality rate goes off from 0.24 to 0.07.

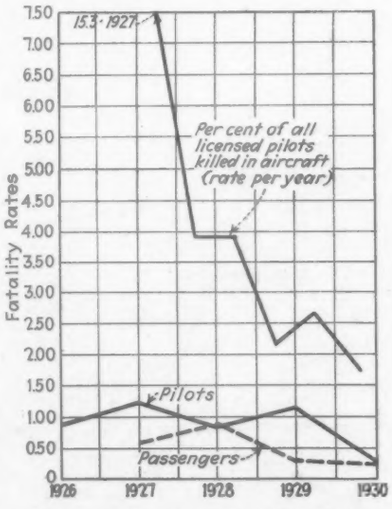
In making comparative studies of pilot hazards, there are two possibilities. The total number of pilot fatalities may be compared with the total number of pilot miles, which of course is equal to the number of airplane miles, giving a figure exactly corresponding to that for passengers. Or, alternatively, the method which the insurance companies prefer may be used, and an accidental death rate calculated for the whole body of pilots or for any particular group among them, without reference to the amount of flying they may do.

Both methods have been employed here. The pilot curve in the lower part of the chart, like the passenger curve, is based on fatalities per million miles of flying on regular scheduled transport routes. The higher, and more sharply descending, curve represents the accidental death rate among licensed pilots, without any reference to whether they are flying much or little, to whether they are highly skilled or relatively incompetent, or to what kind of airplanes they fly in or under what conditions.

The transport pilot curve runs a little above that for passengers, except in the year 1928. It includes flying on night mail routes where no passengers are carried, and where conditions are on the average more hazardous than in passenger transport.

The pilot fatality rate on the regular airways remained virtually constant from 1926 to 1929. In 1930 it dropped to a figure about 50 per cent lower than for any previous single year.

The accidental death rate among licensed pilots as a whole dropped very rapidly from 1927 to 1929, the period in which the Aeronautics Branch of the Department of Commerce was getting a hold on its work and taking measures to eliminate the reckless flyer and the unfit plane. The figure plotted for 1927 is of course absurdly high and results from there having but a very small coverage that year, the average number of licenses in force being only about 400. With 1928 the figures began to have some real meaning. Roughly speaking, the death-rate has been halved since that time, and now stands at just about 2 per cent.



Pilot and Passenger Fatalities per Million Person-Miles, and Accidental Death-Rate Among Pilots

Transport Accident Record

Pilot Fatalities per Million Miles Flown

1918	9.75	1926	0.88
1919	8.67	1927	1.24
1920	7.62	1928	0.84
1921	3.66	1929	1.14
1922	0.57	1930	0.27
1923	2.65		
1924	1.38	Average, 1922-5	1.49
1925	0.40	Average, 1926-30	0.87

Passenger Fatalities per Million Passenger-Miles

1927	0.59	1929	0.28
1928	0.85	1930	0.24

Average, 1927-30 ..... 0.32

AVIATION LAW

STATE law is a source of constant concern to the pilot wandering across unfamiliar country, especially if he be flying an unlicensed airplane. Twenty states now require the federal license for all planes and their pilots, in order that they may operate within state boundaries. Nine more make the same stipulation whenever commercial flying is to be indulged in. Six require some sort of additional action in every case if there is to be a prolonged stay within the state, even with federally licensed equipment. Sometimes a state license must be taken out to supplement the federal one, while in other instances it is only necessary that the pilot file with the local authorities a notification of his presence, but in all six cases some special account may be taken of the state law, and the pilot or owner must inform himself upon what that law is.

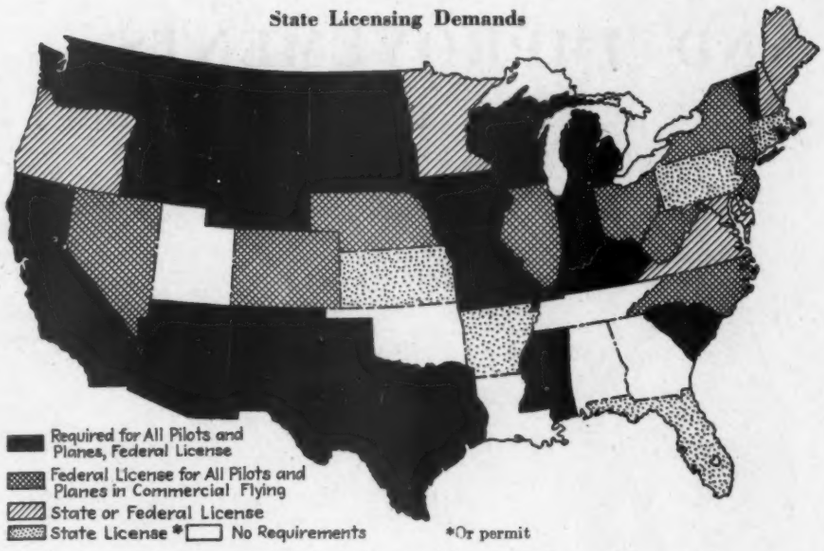
To show the general situation at a glance the map in the upper right-hand corner has been prepared. It indicates, both for the operator of aircraft and for the lawyer, how law-making tendencies vary geographically. As might have been expected, there are marked irregularities in the map, yet it does permit of certain generalizations.

The states of the extreme northwest, the extreme southwest, and the upper Mississippi valley have been the leaders in the movement to make the federal license universal. The southeast, excepting a few commonwealths, has been laggard in taking legislative action to cope with aviation. In accordance with some recent experience in other fields of law and politics, the historic doctrine of state's rights, once the standard to which the South repaired, now seems to find its warmest defenders in the northeast.

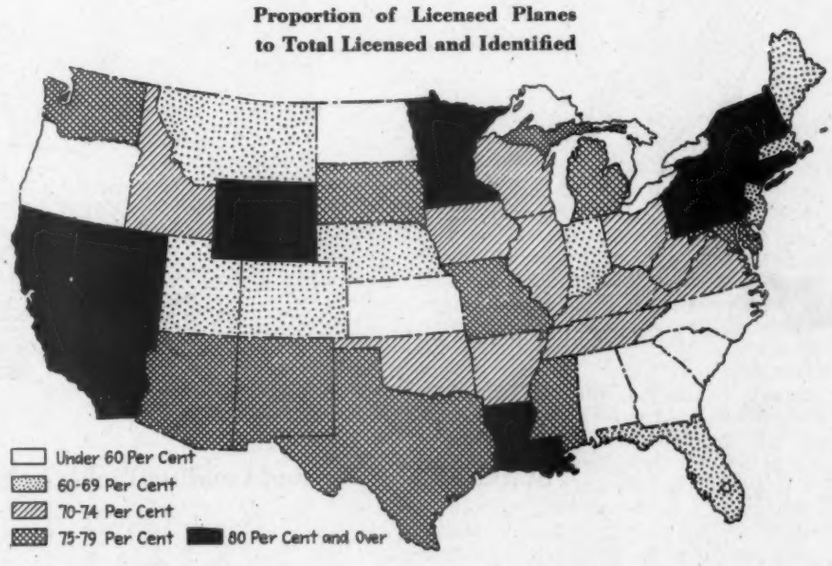
Obviously there should be some relation between the law of a state and the proportion of airplanes in use in that state that hold federal registry. It would appear, for example, that in a state requiring the federal license for all machines any such thing as an identification number should be nonexistent. To show the anticipated relationship between the law and the licensing ratios, the lower map was drawn.

The results were surprising, and although the map is still presented it is useful to show discrepancies rather than parallels. Of the twenty commonwealths that are supposed to prohibit all flying without federal license, only four have less than 20 per cent of unlicensed machines within their borders, according to the records of the Department of Commerce. Four have more than 30 per cent, and two are actually among the seven states that have more than 40 per cent of their planes unlicensed. Of the nine that require the Federal license for all commercial operation within the state, only two can show as many as 75 per cent of licensed machines.

State Licensing Demands


Required for All Pilots and Planes, Federal License
Federal License for All Pilots and Planes in Commercial Flying
State or Federal License
State License *
No Requirements
*Or permit

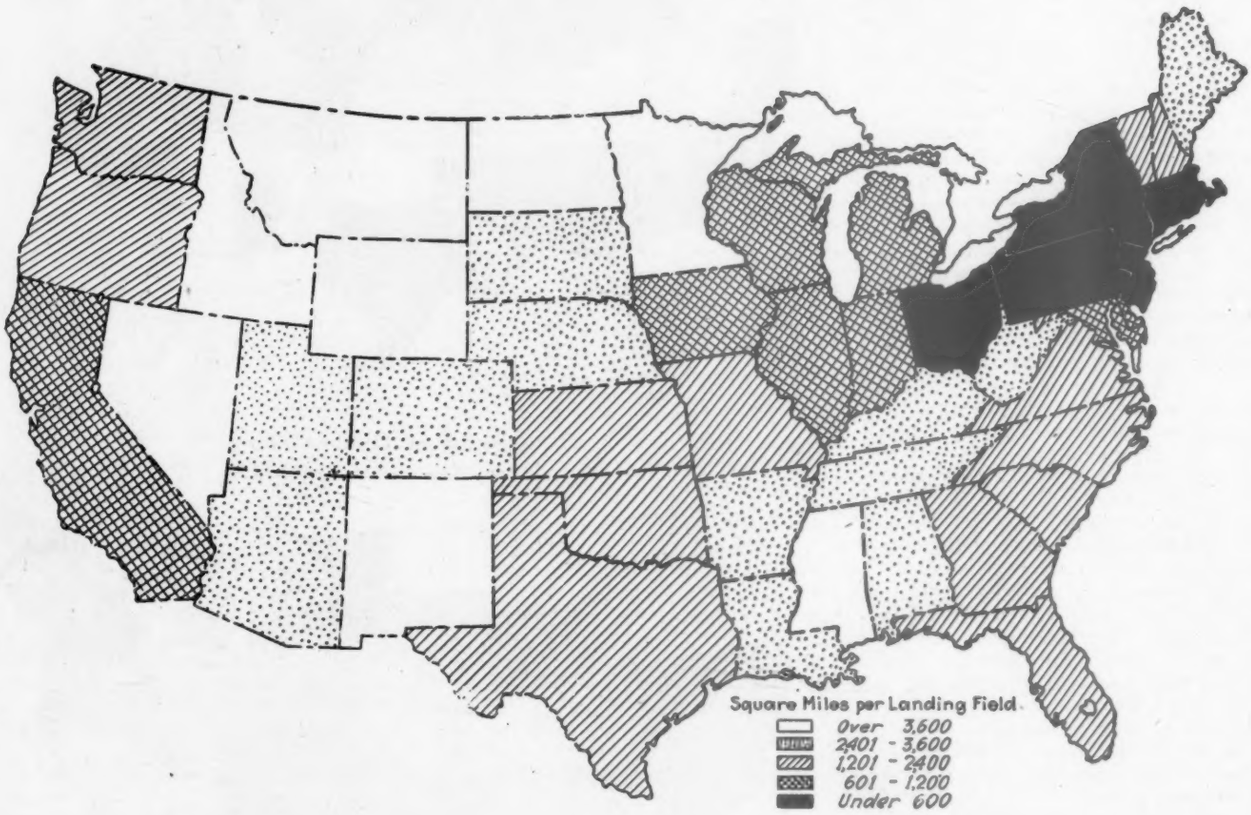
Proportion of Licensed Planes to Total Licensed and Identified



For this strange anomaly there are at least three partial explanations, although, even taking them all together, they hardly seem sufficient to cover the ground. (1) In some states the law seems to be more or less a dead letter, and owners of aircraft go on their unlicensed way in cheerful indifference to its existence; (2) some identified planes are actually in storage and not being flown, and therefore do not come within the scope of the state law; and (3) planes are listed by the Department of Commerce under the state in which their owner has his legal residence, but some of course have their true bases of operations outside its boundaries.

Considering the proportion of licensed planes quite apart from any thought of legal requirement, it appears that New England, the Middle Atlantic states, and California have taken federal licensing most seriously. In California the state law is undoubtedly largely responsible for the low proportion of unlicensed machines. In some other cases, the discrimination displayed by purchasers and users of aircraft and the growing appreciation of the value of a Federal certificate of airworthiness must be the leading factors.

AIRPORT OPERATIONS AND IMPROVEMENTS

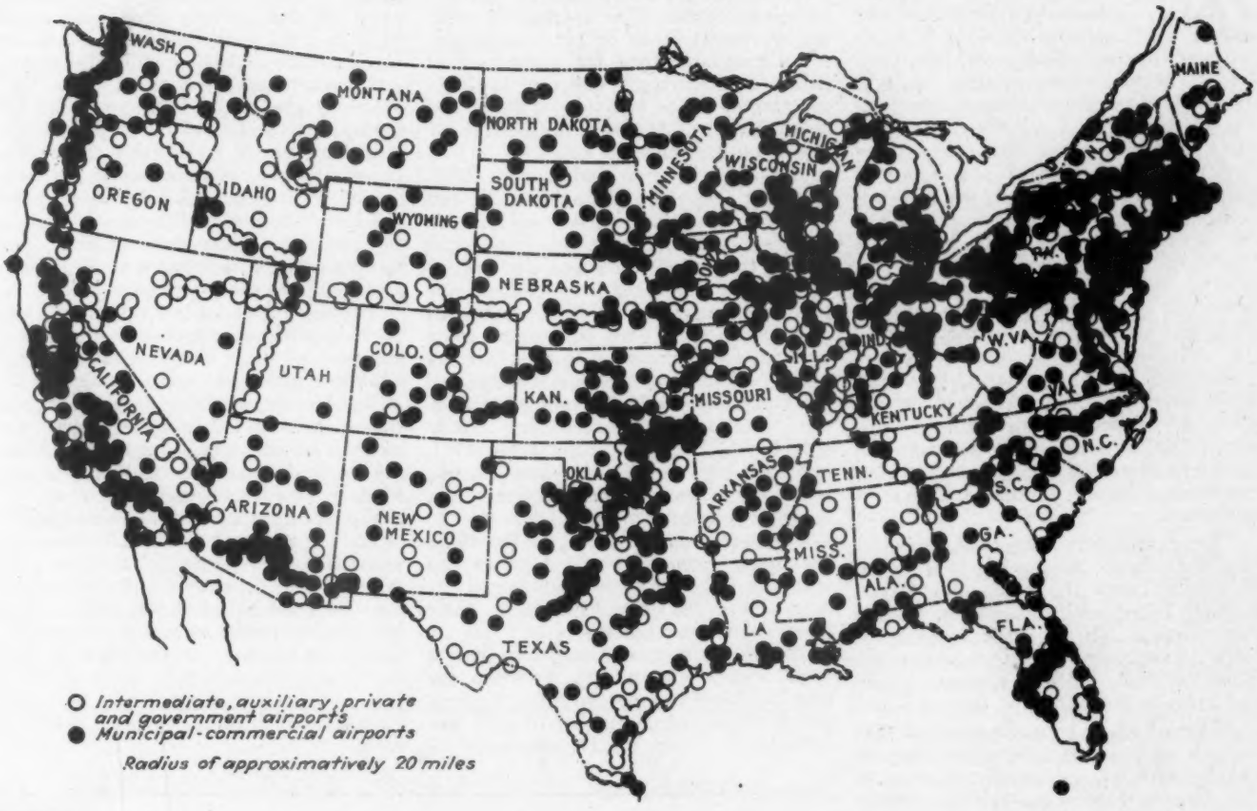


Status of Airports and Landing Fields by States, Dec. 31, 1930

	Municipal	Commercial	Intermediate	Auxiliary	Army and Navy	Total	Square Miles per Field
Alabama	5	5	4	4	1	19	2,737
Arizona	21	5	1	6	1	34	3,352
Arkansas	7	5	0	4	0	16	3,333
California	61	54	24	19	7	165	959
Colorado	15	5	5	5	1	31	3,353
Connecticut	5	5	1	2	0	13	382
Delaware	0	1	0	0	0	2	1,185
D. C.	0	0	0	0	2	2	35
Florida	21	12	3	3	5	44	1,333
Georgia	13	1	15	1	1	31	1,912
Idaho	7	0	10	3	0	21	3,995
Illinois	13	37	16	6	3	75	756
Indiana	7	17	20	3	1	48	757
Iowa	14	16	14	3	0	47	1,195
Kansas	22	21	7	1	2	53	1,550
Kentucky	1	9	5	0	0	15	2,707
Louisiana	6	6	0	2	0	15	3,234
Maine	1	6	0	2	0	10	3,304
Maryland	1	7	2	3	3	17	725
Massachusetts	4	21	2	1	0	28	285
Michigan	28	16	2	4	3	53	1,094
Minnesota	10	6	3	2	0	21	4,032
Mississippi	9	0	0	2	0	11	4,260
Missouri	8	8	12	3	0	31	2,239
Montana	14	5	8	5	0	32	4,594
Nebraska	8	8	12	0	1	29	2,673
Nevada	7	2	15	1	0	25	4,428
New Hampshire	6	1	0	0	0	7	1,334
New Jersey	4	17	2	4	3	30	274
New Mexico	12	4	2	8	1	27	4,542
New York	16	45	10	7	3	82	600
North Carolina	10	6	6	1	1	24	2,184
North Dakota	10	3	0	0	0	13	5,449
Ohio	12	43	18	8	4	85	482
Oklahoma	19	15	7	10	1	52	1,347
Oregon	16	6	19	4	0	45	2,149
Pennsylvania	10	47	28	7	2	94	480
Rhode Island	0	5	0	3	0	8	156
South Carolina	7	5	3	3	0	18	1,722
South Dakota	8	12	2	0	0	22	3,528
Tennessee	5	4	3	3	0	15	2,801
Texas	49	17	20	20	13	119	2,234
Utah	4	0	21	0	0	25	3,400
Vermont	4	2	0	0	1	7	1,366
Virginia	7	11	8	3	5	34	1,254
Washington	13	9	4	4	2	32	2,160
West Virginia	2	6	0	2	0	10	2,417
Wisconsin	17	25	7	3	0	52	1,078
Wyoming	10	1	13	2	0	26	3,766
Totals	549	562	354	177	67	1,716	.....

*Includes 7 miscellaneous government, private and state fields not shown in breakdown by types.

Airport Distribution

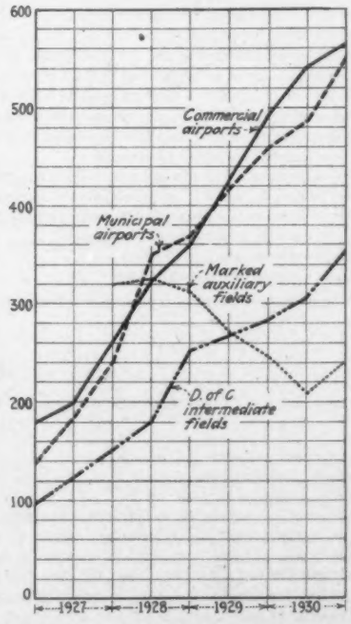


THE map showing the geographical distribution of landing fields retains the general appearance of a year ago. New York has now qualified in the select list of states having at least one field for every 600 sq.mi. of area, while Kentucky, Tennessee, Utah, Colorado, and Maine have also made notable progress and promoted themselves from the lowest grade into a higher one. As might be expected, the landing field density is greatest, other things being equal, in the area where natural fields are scarcest and where anxiety about the results of a forced landing is likely to be most acute.

Natural fields not regularly used for aeronautical purposes, however, are no substitute for airports, and the states that are best furnished with prepared and marked landing-places are showing the results. The greatest relative progress is being made, and the map on page 148 in general shows the largest relative increase in the numbers of planes in use, in the states that are solid black or cross-hatched on the map on the left-hand page. There are, to be sure, some exceptions, such as Kentucky, which have gone ahead briskly in spite of a sparsity of airports.

To insure a really easy use of airplanes and a general availability of air terminals there should be at least one field for every 600 sq.mi. in all the generally settled commonwealths. We should consider that as the minimum acceptable, except perhaps in the states having a large area of almost uninhabitable desert or barren mountainous areas, yet only seven of the 48 commonwealths have attained it.

The map at the top of this page, thickly strewn with dots and circles, shows the location of the individual airports, each one being denoted by a circle 40 mi. in diameter. It has frequently been taken as a reasonable standard of safety in flying that a prepared and marked landing place should always be available within 20 mi., wherever a pilot may be, in case he runs into bad weather or adversity. Only in the sections shown in solid black or completely covered by interlinked circles has that ideal been realized. It is generally attained through the northeastern states, except in the Adirondack mountains and in northern New England, and there is a band of country that is almost continuously covered from New York west to Detroit and Chicago, another southwestward from Chicago and Milwaukee to north central Texas, and another along the Pacific Coast. In the southeastern states, from Virginia and Kentucky down, but excepting Florida, open spaces in the airport map are deplorably large and frequent. The grouping of landing fields, not only of the intermediate class but also regular airports, along transport airways is very plain from the map. Not only the intermediate fields, but also regular airports, are spotted in most thickly close to the natural trade routes on which scheduled services are maintained. The effect is particularly plain along the routes from Salt Lake City to Seattle and to Los Angeles and from Richmond to Atlanta.



Numbers of Airports in Operation, by Classes

Municipal and commercial airports continue on an almost equal footing, so far as total numbers go, but the government-owned fields are definitely gaining. The relative rapidity of increase in the classes, as shown by the curves at the bottom of the page, furnish a striking record of the changes in the popular attitude towards aviation over the last

four years. The latter part of 1927 and the first half of 1928 showed the effect of suddenly-awakened public enthusiasm and of the Lindbergh tour, a feverish activity in the building of municipal fields. Nineteen twenty-nine brought the fruits of the financial boom, an opening of commercial airports on every hand, at the rate of one every three days throughout the year. The financial collapse of late 1929, combined with unfavorable financial returns from some of the newly-established ports, have now had their effect. During the last six months new commercial fields were opened at the rate of less than one per week, but at the same time the pressure for the inauguration of new public works to give employment to labor has made itself felt, and there has been a spurt in municipal construction. Municipal fields seem likely to pass the commercial ones in total number during the coming spring, for the first time in two years.

The marked auxiliary field, never at best more than a feeble stay to the pilot confronted with the need of a forced landing, is constantly waning in relative importance. Three years ago, there were almost two-thirds as many recognized auxiliary fields as airports. Now the ratio is down to less than a sixth.

Although the national totals for municipal and commercial ports are so nearly identical, in certain sections of the country the two are far from equal. In the south and west the municipal fields are almost always in the majority, often in the ratio of two to one or more. In the northeastern group of nineteen states bounded by Wisconsin, Illinois, Kentucky, and Virginia, on the other hand, all except four have more commercial fields than municipal usually many more. As a general rule, municipal airport construction has fared best in regions where there is general acceptance of the idea of governmental operation of public utilities, and where there are no important money marts to facilitate the raising of capital on a large scale for private ventures.

THIS year's analysis of airport operations and improvements includes two sets of figures. One has been compiled from data collected by the Aeronautical Chamber of Commerce, the other from a Department of Commerce study. The tabulation differs somewhat from that of a year ago and direct comparison at most points is impossible.

Again, as last year, the number of municipal airports reporting exceeds the number of commercial and private fields by a considerable margin. The main set of figures, based on the Chamber's data, includes reports from a total of 89 airports, 53 of which are municipal. Reports from these 89 fields may be considered to represent about 30 per cent of the total volume of commercial traffic throughout the country, as a large proportion of the very important fields submitted returns.

Sixty per cent of the above total are municipal ports and they had 74 per cent of the transport passengers carried in 1930 and 64 per cent of the miscellaneous traffic. The average of traffic was obviously about 50 per cent higher for a municipal than for a commercial field. The average number of landings per airport at the commercial fields was about 300, or 3 per cent, under that for the municipal ones.

It is surprising to find that of these, certainly above the average in size and activity, only one quarter cleared as many as 5,000 miscellaneous passengers during the year, or fourteen per day.

By far the greater proportion of the total money devoted to maintenance was spent by cities. They will spend more in 1931, also, according to their present plans. The commercial ports surpassed the municipal ones by a very wide margin in total appropriations for expansion in 1930 and in projects for 1931, but these high figures were due to a few unusually large individual projects. An average would be meaningless.

About twenty per cent of the ports submitting reports recorded substantial increases of landing area during 1930, and forty per cent increased their hangar accommodations.

The Department of Commerce figures offer closer comparison between the municipal and commercial types, because practically an equal number of each was considered. Also, the Department's returns cover virtually all of the operating fields. Average investment per airport and total expenditures to date are about equal but the estimated expenditure for the last half of 1930 (while the survey was being made) and for 1931 is considerably greater for municipal than for commercial fields. This is probably a manifestation of the recent efforts for relief, and also of commercial economy due to the business depression and the difficulty of raising long-term money. It cannot be regarded as typical. The figures probably include both expansion and maintenance appropriations.

The table showing distribution of airports by population groups indicates that in cities of from 5,000 to 100,000 inhabitants municipal and commercial installations are in about equal favor. In the communities larger than that, the commercial airports begin to outnumber the municipal projects and take a particularly commanding position in the group having greater than 500,000 population. In the very small communities, with less than 5,000 population, the municipal fields exceed the commercial ones by about 20 per cent. All of that is quite as might have been expected, especially when it is remembered that the largest cities usually have one and only one municipal project, but may have a number under private management.

Part I

(Based on surveys by the Aeronautical Chamber of Commerce)

	Municipal	Commercial	Total
Number of airports reporting	53	36	89
Number adding at least 50 acres in 1930	13	5	18
Number adding at least 100 acres	10	4	14
Number adding 200 acres or more	3	1	4
Total acres added	2,745	734	3,479
Number adding hard-surfaced runways	9	3	12
Number adding all or part of lighting equipment	19	14	33
Number adding hanger space	23	12	35
Amount spent for maintenance in 1930	$711,919	$194,650	$906,569
Average per port spent for maintenance	$18,734	$12,165	$16,788
Amount spent for expansion in 1930	$127,500	$4,042,500	$4,170,000
(Estimated amount to be spent in 1931 for maintenance)	$470,514	$241,300	$711,814
(Estimated amount to be spent in 1931 for expansion)	$156,781	$2,490,000	$2,646,781
Number clearing 1,000 or more passengers in 1930	15	6	21
Number clearing 5,000 or more transport passengers	10	4	14
Number clearing more than 10,000 transport passengers	5	3	8
Total number transport passengers	258,841	89,941	348,782
Number clearing 1,000 or more miscellaneous passengers*	27	15	42
Number clearing 5,000 or more miscellaneous passengers	13	7	20
Number clearing more than 10,000 miscellaneous passengers	7	4	11
Total number miscellaneous passengers	285,270	161,432	446,702
Average number landings per port	9,273	8,949	9,164
Total number landings (all kinds)	407,541	178,978	586,519

*Miscellaneous passengers consist chiefly of "hop" passengers.

Part II

(Based on survey by the Department of Commerce)

	Municipal	Commercial	Total
No. of ports included	549	564	1,113
Average investment per airport	$106,033	$100,809	$103,386
Total expenditure to date	$58,212,000	$56,856,500	$115,068,500
Total estimated expenditures last half 1930 and for 1931	$15,779,500	$4,445,500	$20,225,000
District of airports by population groups:			
Cties of over 500,000	16	36	52
100,000-500,000	54	70	124
50,000-100,000	37	32	69
25,000- 50,000	54	72	126
5,000- 25,000	190	191	381
Cities of under 5,000	198	163	361

FLYING SCHOOLS

USABLE answers were received from 67 of the flying schools to which questionnaires were sent for information regarding their 1930 operations. This is an increase of six schools over the number which reported for 1929. Since almost all the Department of Commerce approved schools replied, the returns for 1930 may be considered, however, as representing about 45 per cent of this country's flying school activity for the year, as compared with about 25 per cent covered by the reports for 1929. Most of the hundred-odd schools failing to report are of small size.

The two most striking features of the 1930 operations seem to be: (1) a slight but general decrease in tuition fees in all grades and classes of flying instruction; and (2) an increase in the average number of students per school.

In Class A, for instance, the average cost of a transport course was $262, or 6 per cent, lower than in 1929. The cost of a limited commercial course was $102 less and the private course about $75 less. In Class C the transport courses on the average cost $420 less than in 1929, the limited commercial course about $75 less and the private course about $17 less. In general, there is a widening margin between the rates charged by B or C schools and the rates in effect in the A schools. It is the schools making principally a local appeal that have been doing most of the violent price-cutting.

The total enrollment reported last year was 4,452 students. Allowing that the schools reporting cover 45 per cent of the total, the presumption is that 10,000 students formally enrolled for instruction during the year out of a total of 18,000 who took student permits. This shows a situation much the same as the previous year, when the estimate was a total of from 11,000 to 12,000 out of a total of 20,000 permit holders. It would appear that about 40 per cent of those who acquire student permits either never get to the point of actually enrolling for a course or get the permit simply so that they can take informal instruction from their friends.

In the average Class A school each instructor in 1930 was taking care of 24 students at the period of greatest student activity, a substantial increase over the average for 1929. The number of students per instructor in each class was:

	A	B	C
1929	16	15	8
1930	24	21	

The low figure in Group C is no doubt due to most of the instructors in those schools having carried on miscellaneous flying activities on the side, whereas those in the approved schools were more likely to devote their time entirely to instruction.

A necessarily rather sketchy, but nevertheless illuminating, analysis of the purpose of students taking instructions in the various grades shows that in the Class A school there were even more students in 1930 who planned to secure appointments as transport pilots than there were in 1929. The other two classes, however, reported a decrease in transport aspirants. There was a universal drop in the proportion of students known to be planning to buy private planes. That, of course, may be simply a temporary reaction to the general business depression.

One of the chief problems of the inexperienced pilot has been the renting of planes at a reasonable rate to keep up his skill. Of the schools reporting for this survey, practically all have arrangements by which planes may be rented to graduate students. The average rental rate per hour is around $18 in all groups of schools. Rates ranged from $10 to as high as $30 per hour for two- and three-passenger planes.

The great majority of these reporting schools permit instruction on the pay-as-you-go basis. That is, students may pay for an hour's instruction as they take it, without contracting or paying in advance for a complete course. In most cases, the pay-as-you-go system has no time limit within which the instruction must be completed or abandoned.

It is interesting to note that most of the schools in Class A were founded within the last two or three years. More than half, in fact, opened their doors for the first time in 1929. Just about half of them were able to report a complete calendar year of operation as approved schools.

Tabulation of Flying School Questionnaire Answers

	A		B		C	
	1929	1930	1929	1930	1929	1930
Total number of schools reporting	13	36	28	6	20	25
Number of schools having operated at least since 1925	6	3	6	3	2	2
Average number of flying instructors per school	3.5	2.1	2.0	3	1.4	2.2
Average number of ground instructors per school	4.6	3	2.5	1.8	1.8	1.2
Average number of graduates per school since starting operations	225	142.9	70	155.4	11	60.2
Average number of graduates from transport course	2.5	5.9	1.3	3.5	0.4	1.1
Average number of graduates from limited commercial course	13.0	22.4	8.4	15.6	1.5	3.2
Average number of graduates from private course	23.0	28.1	23.0	30.3	6.8	11.1
Total number of students enrolled	1,130	3,553	1,462	395	286	504
Average number enrolled per school	87	98.6	54	65.8	16	21
Average maximum number of students under instruction at any one time	55	50.6	31	37	16	18.1
Median charge for transport course*	$4,100.00	$3,837.50	$3,400.00	$2,875.00	$3,500.00	$3,080.00
Median charge for limited commercial course*	$1,300.00	$1,197.50	$1,090.00	$862.50	$1,125.00	$1,050.00
Median charge for private course*	$550.00	$475.00	$490.00	$360.00	$480.00	$462.50
Median estimate of school operators of percentage of students planning to secure employment as transport pilots	55	65	50	37.5	50	48
Median estimate of percentage looking forward to employment in the aircraft industry, but with only incidental piloting	20	15	20	17.5	20	20
Median estimate of percentage planning to purchase private airplanes	10	8.5	20	10	25	20
Number which rent planes to graduate students	.....	34	.....	6	.....	24
Average rental rate per hour	.....	$18	.....	$18	.....	$17.50
Number which permit instruction "on pay-as-you-go" basis	.....	30	.....	3	.....	24

*The median is slightly superior to the ordinary arithmetical average as a means of showing the trend in such a figure as this. Those of our readers who are not familiar with the term and its use can consider it as being the average charge, from which it would differ only slightly.

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FINANCIAL RECORD OF REPRESENTATIVE AERONAUTICAL COMPANIES

(Comment on page 164)

Corporations	Division	Capital No. of Shares (000 Omitted) Pfd.	Com.	Par Value	Original Offering Price	Market	Securities Price Range 1928-1929 H.	L.	1930 H.	L.	Volume	Earnings (*Italics* Represent Deficiencies) 1928	1929	1930	Earnings per Share	Rate of Dividends
Aeronautical Industries[6]	Financial		125	No		C	31⅛	7	15	7	7,500		*1,184,922*			
Aeromarine-Klemm	Manufacturing		242	$5		P	10⅜	¼	2	.05	33,500					
Aero Supply Mfg. "B"	Accessories	21	391	No	15.00	C	75	8	13⅞	3½	400,000	90,713	223,418		.48	
Aero Underwriters	Insurance		142	No		CD	48½	13	23⅛	5	28,577		281,844		1.99	
Air Investors, v.t.c.	Investment		165	No		C	20⅛	3	9½	⅛	42,300		125,568			
Air Investors, conv. pt.	Investment	82		No		C	40⅞	10	24	4	25,900		ditto			
Alexander Industries	Manufacturing	6	300	$1.	1.00	C	23	1⅛	4½	⅛	35,000	162,220	*288,076*	**44,146*		
Allied Aviation	Manufacturing		110	No	14.50	C	15½	⅛	3	⅛	42,000		*168,191*			
Allied Motor Industries	Manufacturing	25	239	No	49.50	CE	52	12	19½	⅛	135,500	340,000	211,599		.48	
American Eagle Aircraft	Manufacturing		490	No		P	6	⅛	1⅛	⅛	186,700		44,038			
Aviation Corp. of America	Transport		321	No	X	C	89⅛	20½	55	16⅛	144,163	*29,659*	*317,412*			
Aviation Corp. of Del.	Holding Corp.		3,185	No	20.00	AHJ	20	4½	9⅛	2⅛	1,653,700	789,000	*1,443,822*	*†4,022,154*	*Nil*	
Aviation Credit Corp[7]	Finance		250	No		C	23⅛	12	22⅛	12⅛	81,600		275,000		1.10	
Aviation Securities Corp.	Investment		146	No		C	49½	6	19	7½	36,100		*1,189,075*	489,119	3.25	
Axelson Aircraft	Manufacturing		95	No		J	22⅛	7	11½	.75c	14,800					
Bach Aircraft	Manufacturing		850	No		JH	3.85	.15	.44	.05	287,865					
Bellanca Aircraft	Manufacturing		175	No	23.50	C	24	4½	18⅛	2⅛	32,100	*180,000*	*109,148*			
Bendix Aviation	Accessories		2,097	No		AEH	104⅛	25	57⅛	14½	3,385,122		7,416,408	†1,718,184	.81	2.00
Berliner-Joyce[4]	Manufacturing	40	30	No		R	26	15	15½	2	1,520					
Bird Aircraft[5]	Manufacturing		70	No		P			2⅛	½	9,100					
Central Airport	Airport		206	No		N	12⅛	6	7	2			*19,233*		*Nil*	
Consolidated Aircraft	Manufacturing		579	No	25.00	C	44⅛	13½	27⅛	6⅛	48,700	1,314,500	952,027		1.64	
Curtiss Aero & Motor[1]	Manufacturing		19	No		A	192⅛	50				1,528,782	624,000	*†91,804*	3.93	(C-W)
Curtiss Airports, v.t.c.[1]	Airport		2,500	No		CFJ	13½	2⅛	6½	⅛	52,905					(C-W)
Curtiss Flying Service[1]	Service		750	No		CF	29⅞	4⅛	12	2	36,625					(C-W)
Curtiss-Reid (P,F,D.)[1]	Manufacturing	50	100	$30		C	35	15	9⅜	3	1,200		*133,322*		*Nil*	(C-W)
Curtiss-Wright, Com.	Holding Corp.		6,284	No	30.00	AH	30⅛	6⅛	14⅞	1⅞	4,847,424	4,974,000	*668,532*	*†7,159,255*	*Nil*	
Curtiss-Wright "A"	Holding Corp.	1,130		No		A	37⅞	13½	19⅜	3	806,250	ditto	ditto	ditto	*Nil*	
Curtiss-Wright Export[1]	Sales	4	82	No		C	52⅞	8⅛	14	14	100	936				(C-W)
Dayton Airplane Engine	Manufacturing		100	No	16.50	C	46⅞	3½	8⅛	1⅞	141,300					
De Havilland (Am. rts.)	Holding		400	£1		C	10⅜	4½	8⅛	4½	15,300	£96,719	£236,000	£36,543	9.13%	.25
Detroit Aircraft	Holding		888	No	15.00	CFDHJ	17⅛	5⅛	9½	1⅛	656,360		*733,077*		*Nil*	
Douglas Aircraft	Manufacturing		399	No		CIG	45½	12⅛	23½	11⅛	313,055	370,717	403,363	685,979	2.01	.75
Ex-Cell-O Aircraft & Tool	Accessories		200	No	23.50	CK	36	15	22⅛	5⅛	267,329	280,000	719,000	**68,187*	2.12	.80
Fairchild Aviation	Manufacturing		560	No	22.00	C	33	3	11	⅜	67,874	*95,318*	*2,094,479*		*Nil*	
Fairey Aviation, Ltd. (Am.shs.)	Holding		1,000	10s.		C	6½	2⅜	2⅜	2	15,800		£164,953	£169,964	26.79%	
Federal Aviation	Manufacturing				22.50	P			4½	3½	200					
General Aviation (Fokker)	Manufacturing	30	950	No	12.50	CHJ	67½	8	34⅜	4⅜	680,153		403,937		.37	
Great Lakes Aircraft	Manufacturing		500	No		E	33	4	8⅛	1	203,500	342,794	*848,841*		*Nil*	
Handley-Page, Ltd. (Am. rts.)	Holding	498	150	5s.		C	5⅜	2	3½	2⅛	16,300	£47,795	£40,508		7.5%	
Irving Air Chute	Accessories		209	No	25.00	CH	41⅜	12	27	6	139,100	414,376	444,745	241,697	1.14	1.50
Kinner A. & M. Corp.	Manufacturing		1,946	$1.		JPH	6⅜	⅜	1⅜	¼	1,090,045		*38,906*	*†101,313*	*Nil*	
Lockheed Aircraft	Manufacturing		138	No		OJ	22	7	5⅞	1.55	8,365					
National Air Transport[3]	Transport		650	No		A	48½	10	39⅜	6	973,106	274,180	669,296	**347,227*		
National Aviation	Investment		234	No		C	88	6½	21⅛	3½	224,900	65,520	241,992	*1,677,070*		
N. Y. R. & B. A. Lines[2]	Transport		267	No		C	19	5								
Nicholas-Beazley	Manufacturing				20.50	S	20½	5	7⅜	1	5,395	224,304	*10,732*			
North American Aviation	Holding		2,000	No		ADH	64⅜	15	1⅜	4½	1,339,672	8,859	1,908,819	†1,571,269	† .75	
Roosevelt Field	Airport		360	No		CF	18	3½	5½	1½	154,715		68,400			
Sky Specialties Corp.	Accessories		125	No		OP	24	18	17	10	300					
Stinson Aircraft	Manufacturing		124	No	26.50	KF	26½	12⅜	31½	15⅜	130,110	128,000	14,000		.11	
Swallow Airplane Corp.	Manufacturing		49	No		OP	13⅜	5	3	3	200					
Thompson Aero	Transport					L	30	9⅜	17	6	1,317					
Transcontinental Air Trans.	Transport		750	No		CGJ	35	7	10⅛	3⅜	368,950	798	*986,591*			
United Aircraft & Transport	Holding	240		No		AH	109½	44⅛	77⅜	41⅜	108,050	4,461,935	8,966,031	†3,252,145		
United Aircraft & Transport	Holding		1,838	No	30.00	AHJ	162	31	99	18⅜	11,093,230	ditto	ditto	ditto		
Waco Aircraft	Manufacturing		145	No	23.50	M	28	6½	10½	3	3,869	384,323	109,000	**36,918*		
Warner Aircraft	Manufacturing		400	No		KP	39⅜	2⅜	9⅜	⅛	228,514	*24,000*	*39,965*			
Western Air Express	Transport		135	$10.	45.00	CIH	78½	15	46⅞	9⅜	98,250	720,778	1,087,852		7.15	* .60
Whittelsey Mfg. Co.	Manufacturing	240	420	No	12.50	DP	15	1	2⅛	.08c	17,324					
Wing Aero	Accessories					P			12⅛		7,200					
Wright Aeronautical[1]	Manufacturing		600	No		A	299	30	59⅜	10⅛	5,820	2 433,771	901,000	*†1,932,189*	*Nil*	(C-W)

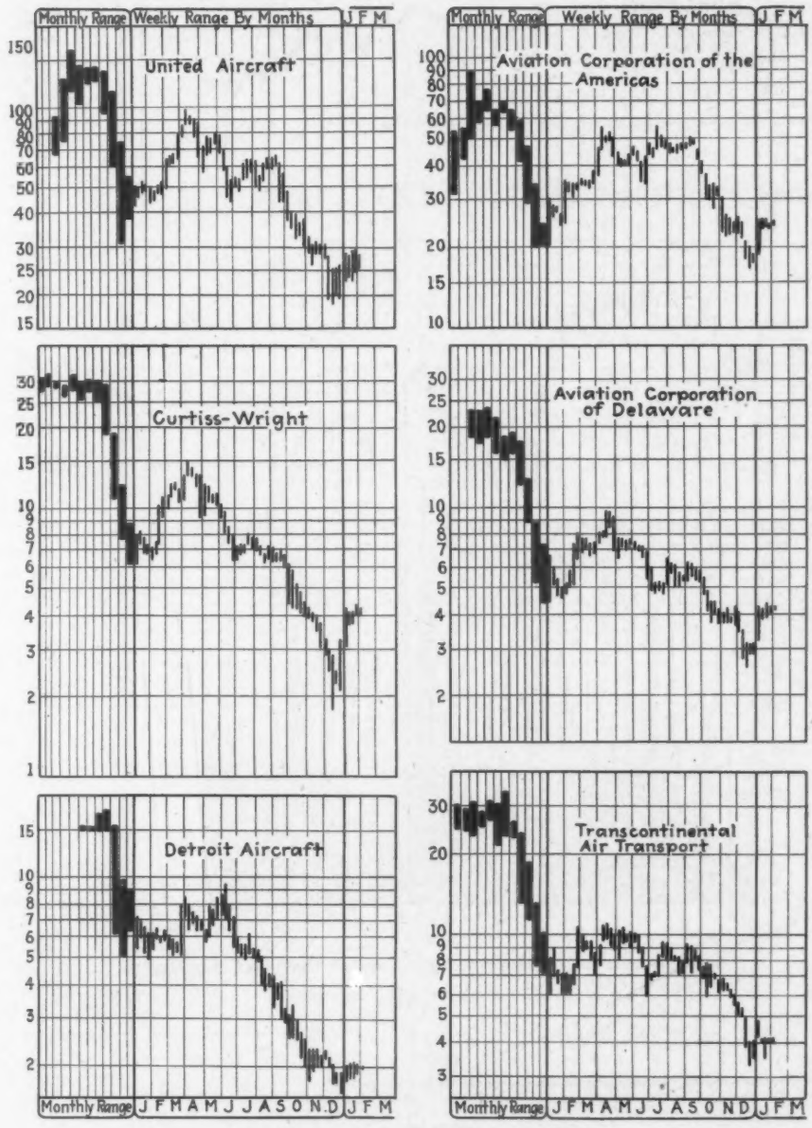
(The figures given in the above table, while not guaranteed, were obtained from sources believed to be correct.)

1 Now controlled by Curtiss Wright Corp.
2 Now controlled by United Aircraft & Transport
3 Acquired by Aviation Corp. of the Americas
4 Subsidiary of North American Aviation
5 Formerly Brunner Winkle
6 Controlled by National Aviation
7 Removed from list in 1930

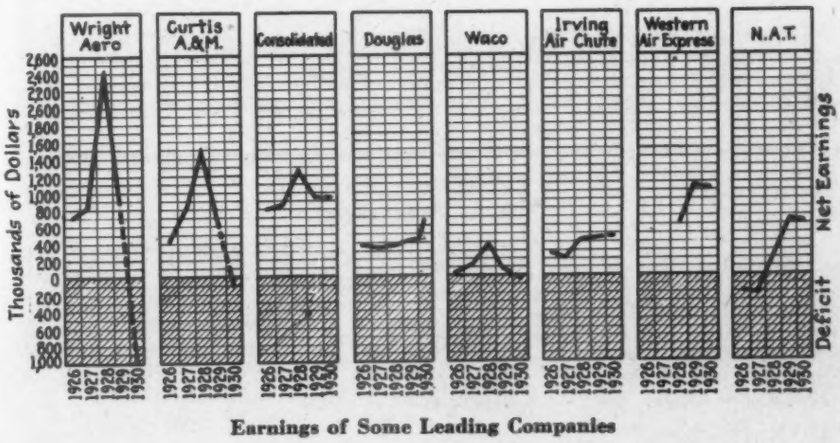
X Offered privately
A New York Stock Exchange
C New York Curb Exchange
P New York Produce Exchange
O Open Market
D Boston Stock Exchange
E Chicago Stock Exchange
F Chicago Curb Exchange
I Los Angeles Stock Exchange
J Los Angeles Curb Exchange
K Detroit Stock Exchange
L Cleveland Stock Exchange
M Cincinnati Stock Exchange
N Philadelphia Stock Exchange
S St. Louis Stock Exchange
R Baltimore Stock Exchange
H San Francisco Curb Exchange
G San Francisco Stock Exchange
* Six months
† Nine months.

Charts and Tabulations Prepared by R. R. Doane

AERONAUTICAL FINANCE


Monthly Range
Weekly Range By Months
J F M
United Aircraft
Aviation Corporation of the Americas
Curtiss-Wright
Aviation Corporation of Delaware
Detroit Aircraft
Transcontinental Air Transport
Monthly Range J F M A M J J A S O N D J F M

Price Movements of 1929 and 1930



Earnings of Some Leading Companies

IN reviewing the financial statistical position of the aeronautical industry there is no broad general-purpose measuring rod that may be made to serve any more readily than the movements of the individual corporation securities themselves. Here the effects of the conditions underlying trade and commerce are quickly reflected, as well as the varying estimates of each individual company's credit, earnings, and productive position, in its resistance or vulnerability to the general trend.

Broadly speaking, corporate securities represent claims against the results of production. When production is progressing satisfactorily, profits are normally increasing and the claims against a share of these profits, whether to be immediately distributed or withheld for the future, usually move upward in value. For this reason, rather than that of any purely speculative interest, the table of security price changes has been reproduced on the following page.

Quite aside from all artificial attempts at stock manipulation security prices have a tendency to gravitate toward the level of their intrinsic value. In fact, in times of strain upon the entire industrial structure corporate securities invariably fall, for a time, below such values.

In general, and in fact even more plainly than in 1929, the movements of aviation stocks have again followed those of the general market. Our aviation stock average and the New York *Times* industrial average recovered together from the debacle of November, 1929, to a new high in April. They slumped together to a new low in December, 1930, marking a depreciation of the aviation average to 88 per cent below the 1929 high and 42 per cent below the 1929 low. The corresponding figures for the general industrial average were 60 per cent and 14 per cent.

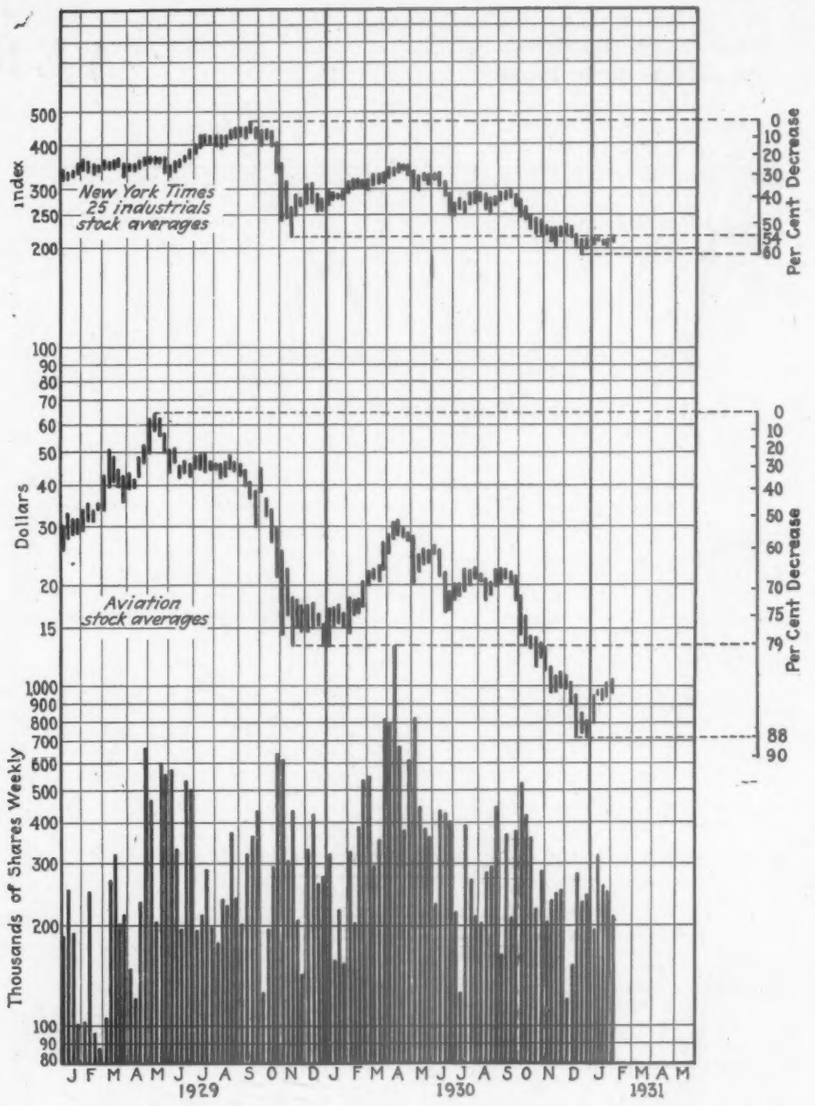
The early spring rise was attended by a display of great public interest, the

volume of trading in aviation securities actually exceeding the maximum for the bull market of the previous year. The peak of activity was reached during the struggle for possession of National Air Transport in March and April, in the course of which United Aircraft got back to within 40 per cent of its 1929 high.

Individual stocks moved in much the same fashion as the averages. Curtiss-Wright and United Aircraft both showed great strength in the early spring, followed by a long and severe decline. Detroit Aircraft continued to climb gradually to higher levels, attaining its peak about the middle of June and then it, too, fell off to a new low record. Of the stocks here reported, the Aviation Corporation of the Americas was least disturbed by the reactions of the other aeronautical securities until early fall, when its prices began to decrease with the drop in the general market.

The first few weeks of 1931 showed a marked improvement in almost all of the securities tabulated, particularly in Curtiss-Wright and Aviation Corporation of Delaware.

The table on page 162 represents the most complete and authoritative financial record that could be secured for all companies in the stock of which there has been any general trading in any American market. It is of course very possible that some errors have found their way into the tabulation, but it is based on information which we believe to be reliable. In a number of cases records are included, for the sake of completeness and to permit of tracing financial history through mergers and other changes, on companies which are no longer active as independent units and of which the stock is no longer the subject of independent trading. Even companies which have been entirely taken over and surrendered their corporate identity are listed, provided they have been in business at some time within the past couple of years.


Index
New York Times 25 industrials stock averages
Per Cent Decrease
Dollars
Aviation stock averages
Per Cent Decrease
Thousands of Shares Weekly
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M
1929
1930
1931

Movements of the Averages, and Volume of Trading in Leading Aviation Securities

NATIONAL AERONAUTIC ASSOCIATION

AS MIGHT be expected from the general economic condition and from the slackening of the public excitement over aviation that had been aroused by the spectacular flights of 1927 and 1928, the growth of the National Aeronautic Association's membership has slowed down materially during the past couple of years. Although no exact figure for the end of 1930 could be obtained, it appears that the membership has remained almost constant through the last two years. Interest in the Association's activities is, however, being spread out more evenly over the country, for the number of chapters continues to increase.

The principal function of the N.A.A. is of course the control of contests and of record attempts, and there was more activity in that sphere during 1930 than during any previous year. The number of F.A.I. certificates given passed 500 for the first time, but even so, only about 10 per cent of the

N.A.A. Activities

	1925	1926	1927	1928	1929	1930
Membership at end of year	5,100	4,800	5,660	7,200	7,632	7,000[1]
Chapters formed up to end of year	....	71	98	158	194	236
Number of F.A.I. certificates issued during year	175	209	200	242	400	504
Number of N.A.A. sporting licenses issued	427	539	394	559	685	855
Number of race meets sanctioned	....	10	11	16	35	60*
Number of air tours sanctioned	....	1	1	1	6	8

*Including air circuses. [1] Over 7,000, exact figure not obtainable.

pilots newly licensed during the year by the Department of Commerce took the trouble to get the F.A.I. document. It will be recalled, of course, that the F.A.I. certificate is issued once and for all and that it is the prerequisite to any competitive flying, while the sporting license, also required for entry in a sanctioned contest, must be renewed each year. The number of sporting licenses issued is therefore an index to the total number of pilots who are qualified for competition. At the end of 1928 it amounted to 12 per cent of the total number of pilots licensed by the Department of Commerce. At the end of 1929 it had dropped off to 7 per cent, and now it is down to 6 per cent.

In spite of the criticism that has been lavished upon the management of races and upon their value as public spectacles, there is no evidence of decrease of interest in race promotion. There were almost as many sanctioned events last year as in the three previous years combined. The number of tours also exceeded the previous record.

NATIONAL ADVISORY COMMITTEE

THE operations of 1930 and the budget for the coming fiscal year show a continuation of the steady advance that has marked the Advisory Committee's recent record. The suddenly increased demand for the Committee's publications in 1927, with a further increase in their circulation in every succeeding year, was of course due partially to the growth of the aircraft industry and the expansion of its personnel. It represents also, however, an enlarged interest in research on the part of the industry. The first upturn in the curve of publications distributed was synchronous with the first of the annual conferences with the aircraft industry at Langley Field.

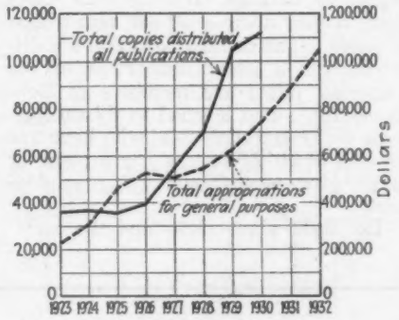
Too much stress must not be laid on the figures for new reports and technical notes originating at Langley Field. A single report like that on the cowling of aircooled engines may represent a year's labor. Furthermore, these tables carry no direct record of the time and money spent on researches for the Air Corps and the Navy, with the results kept confidential for military reasons, nor of the work done upon such miscellany as the examination of aeronautical inventions and designs and the maintenance of a European office to keep abreast of technical developments abroad.

Appropriations and Personnel of N.A.C.A.

Fiscal Year	Total Appropriations	Employees at Langley Field Laboratories
1923	$225,600	53
1924	307,000	77
1925	470,000	107
1926	534,000	121
1927	513,000	141
1928	550,000	156
1929	628,770	177
1930	*1,508,000	197
1931	*1,321,000	236
1932	1,053,790[1]	...

*Material increase includes $763,000 in 1930 and $435,000 in 1931 for construction of full scale wind tunnel, seaplane channel, and heating plant. Amounts available for general purposes, $745,000 for 1930 and $886,000 for 1931.

[1]Tentative only. Bill now before Congress.



N.A.C.A. Activities

Publications of N.A.C.A.

	Technical Reports	Technical Notes	Technical Memorandums	Aircraft Circulars	Total Copies Distributed
1923	21	51	67	..	36,870
1924	23	37	52	..	37,209
1925	22	19	49	..	35,884
1926	27	24	47	26	39,207
1927	28	17	52	38	55,636
1928	20	30	50	23	70,663
1929	35	28	52	19	104,076
1930	32	30	54	25	112,010

	Technical Reports		Technical Notes	
	Originating with N.A.C.A.	All other sources	Originating with N.A.C.A.	All other sources
1923	8	13	11	40
1924	10	13	15	22
1925	8	14	12	7
1926	14	13	19	5
1927	17	11	10	7
1928	15	5	20	10
1929	20	15	19	9
1930	17	15	19	11

WEATHER BUREAU

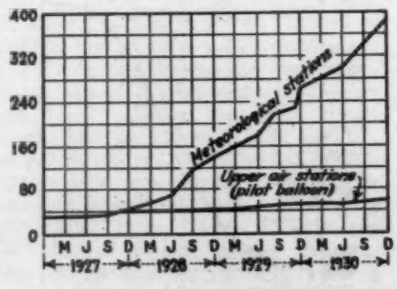
IT IS an index of the growing realization of the importance of meteorological work in air navigation that the ratio of the Weather Bureau's aeronautical expenditures to the ground to be covered has steadily increased. Putting it in terms of mileage of air routes requiring protection, the outlay has ranged from $10 per domestic mail route mile in 1927 up to $15 in 1929, and $42 during the present fiscal year. The earlier sums are of course in a sense fictitious, and simply indicate that no serious effort was being made to cover more than a small part of the total length of the routes operating at that time.

The number of special meteorological stations on airways has been increasing in a similar ratio. At the beginning of 1927 there was one for every 260 miles of domestic air mail routes. In the succeeding years that ratio has changed successively to one for every 185, 100, 90, and 83 miles.

Special Appropriations for Weather Service on Civil Railways

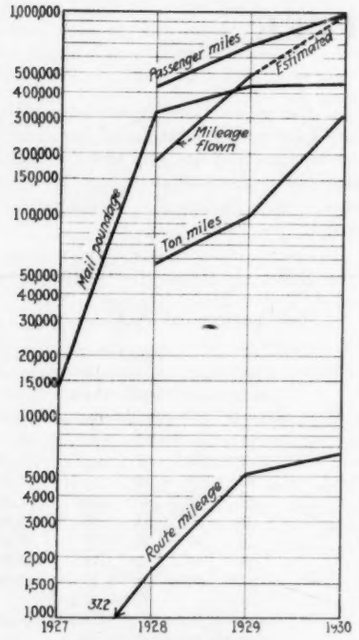
Fiscal Year Ending June 30		Fiscal Year Ending June 30	
1927	$75,000	1930	$710,080
1928	120,000	1931	1,272,660
1929	243,500	1932	*1,622,880

*Not yet appropriated by the present Congress; this amount contained in Appropriation Act as it passed the House.

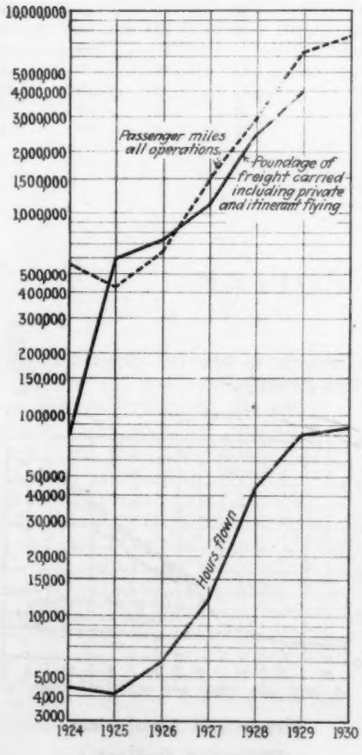


Airway and Aerological Observing Stations

CANADIAN AVIATION



Contract Mail Route Operations

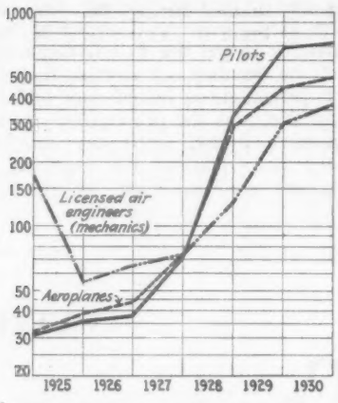


Total Flying Activities

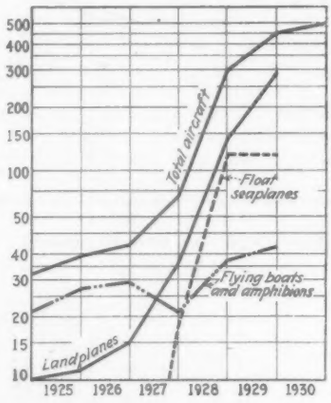
THE course of Canadian aviation has roughly paralleled that of development in the United States, with a great boom from 1927 to 1929 and a slackening of progress in construction of new planes and training of personnel during 1930. As in the United States, however, the slowing down in the past year did not extend to air transport, which went ahead briskly.

The total number of planes has been increasing with just about the same rapidity as in the United States, the ratio of the two countries staying very close to 20 to 1. It is not far from the ratio of the populations, the per capita plane ownership being almost identical in the two cases. Another similarity is found in the pilot curve. In Canada as in the United States, the numbers of planes and the pilots were nearly the same up through 1928. In 1929 they began to diverge, and in both cases there is now about a 50 per cent excess of pilots. The causes, however, are different, for a great proportion of the Canadian pilots are members of light plane clubs, who learned to fly through their club connections and who have had no idea of either purchasing a plane or of securing professional flying employment.

The light plane clubs and the introduction of the DH Moth are also responsible for the rapidly increasing proportion of landplanes on the registry list. At the end of 1926 only about a



Flying Personnel in Canada



Airplanes Licensed

Contract Air Mail Services

	Route Miles	Mail Carried (Pounds) 1929	Mail Carried (Pounds) 1930	Approximate Total Mileage 1929
Bessett-Lac du Bonnet	82	18,926	13,915	7,774
Chibougamau-Oskelaneo	190	447	1,930	520
Leamington-Pelee Island	22	24,431	16,368	4,928
Moncton-Charlottetown	110	59,712	43,845	13,183
Moncton-Magdalen Islands	200	7,444	8,154	2,400
Montreal-Albany	200	20,680	21,688	57,145
Montreal-Detroit	588	18,401	30,402	146,846
Montreal-Moncton, via St. John	467	1,118*	7,245	14,746*
Montreal-Ottawa	110	2,801	2,600	5,610
Montreal-Quebec	134	.....	2,521	.....
Montreal-Rimouski	330	68,672	53,542	35,558
Narrow Lake-Sioux Lookout	336	83,406**	39,519	22,890**
Quebec-Seven Islands	350	30,055	26,697	22,510
Seven Islands-Anticosti	120	3,623	4,438	1,200
Toronto-Buffalo	100	27,909	43,829	15,273
Trans-Prairie Service	1,263	.....	64,020	.....
Peace River-North Vermilion	167	.....	.....	.....
Amos-Siscoe	42	.....	2,706	.....
Fort McMurray-Aklavik	1,676	12,849	49,386	17,093
Special flights	.....	918	14,283	1,672
Cranberry Portage-Kississing	*45*	*36,388*	.....	*7,250*
St. John-Halifax	*186*	*2,021*	.....	*5,040*
Ottawa-St. John-Montreal	*711*	*3,161*	.....	*11,424*
Totals	6,487[1]	430,636	447,088	[1]90,640

Italics: 1929 only. *Montreal-St. John, in 1929. **Sioux Lookout-Red Lake Area, in 1929. [1]1930 total, excluding routes given only in 1929

third of the machines in Canada were landplanes and the flying fields were few.

At the end of 1930 the proportion had increased to two-thirds, and the amphibion was gaining ground at the expense of the float seaplane. Of course these figures are subject to some error from the fact, already mentioned in the section on production and licensing, that the same machine may be a landplane today and a float seaplane tomorrow. The tendency towards wheel landing gears, with or without amphibion provision, is nevertheless undoubtedly a real one.

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ALTHOUGH no complete and up-to-date returns on Canadian licensing are available, figures of last summer show a total of 477 planes, of which 227, or almost a half, were designed in the United States and in recent years. A great majority of them were also built there, but a number were of course the work of Canadian assembling plants or licensees. The leading American makes in number were Fairchild with 47, Fokker with 35 (almost all of them Super-Universals), Travel Air with 17, and Waco with 10. A number of other makes had six to nine each.

Far in the lead among individual types on the Canadian list is the DH Moth, which is what might be expected, since it is the plane officially approved for the light plane clubs. At the time when these figures were taken, there were 151 Moths, not counting five of the Puss Moth, or cabin type. Some of them were imported from England, but a large part are of Canadian manufacture. The Canadian Vickers factory had six machines on the list, the Reid plant in Montreal, 19. About 25 planes, or five per cent of the total, are still of wartime types, mostly HS flying boats.

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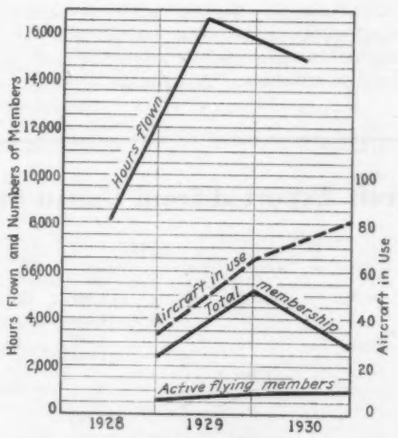
THE total volume of flying in Canada increased last year by about 10 per cent, or in about the same ratio as the number of airplanes. The average per machine remains at about 180 hr. a year.

Transport operations are organized through contract air mail service much as in the United States and covered approximately twice the total mileage that was flown in 1929. Passenger traffic went up 50 per cent, mail and express more than 200 per cent. The Canadian airways are now the only ones in the world of any importance upon which the mail and express handled represent more than 50 per cent of the total traffic in ton-mile units.

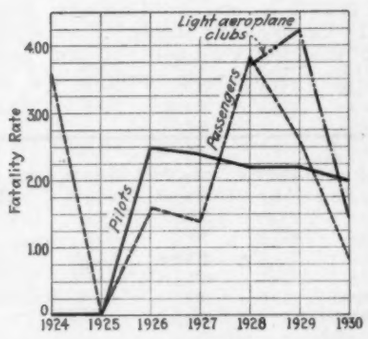
Although several new routes were opened in 1930 and the average distance that a letter was carried increased over the previous year, the mail poundage figures were quite disappointing. The gain in total poundage over 1929 was only 4 per cent, and seven of the sixteen routes that operated in both years showed an actual drop in the weight of mail carried.

Light Aeroplane Club Operations

	1930 Flying Members	1930 Aircraft	Hours Flown Yearly 1928	1929	1930
1. Aero Club of B. C.	38	4	.....	627	671
2. Brandon Aero Club	22	2	.....	119	270
3. Brant & Norfolk	35	2	.....	210	351
4. Border Cities	87	4	342	992	657
5. Cape Breton	16	2	.....	222	405
6. Calgary Aero Club	47	2	350	1,256	476
7. Edmonton & N. Alta.	47	5	416	1,080	1,750
8. Fort Wm. Aero Club	21	4	.....	559	703
9. Granby Aero Club	...	..	199	242	.....
10. Halifax Aero Club	7	0	207	293	361
11. Hamilton Aero Club	91	4	539	706	747
12. Kingston Flying Club	23	4	.....	570	696
13. London Flying Club	33	4	269	398	628
14. Montreal Light A. Club	90	7	946	1,069	1,249
15. Moose Jaw Flying Club	37	3	537	853	546
16. Ottawa Flying Club	35	6	741	1,290	800
17. Regina Flying Club	93	6	503	1,158	588
18. Saskatoon Aero Club	86	4	727	1,156	644
19. St. John Flying Club	61	2	.....	317	485
20. St. Catherines Flying Club	22	2	.....	483	568
21. Toronto Flying Club	52	6	1,218	1,515	1,311
22. Victoria Flying Club	...	..	128	34	.....
23. Winnipeg Flying Club	24	8	1,004	1,464	926
Total	967	81	8,125	16,613	14,832



Light Aeroplane Club Expansion



Accident Data, All Classes of Flying

THE light plane clubs have gone along very much as in 1929. Two of the least active of the 23 clubs dropped out during the year, but most of the remainder increased their operations. Edmonton, which had stood only seventh in flying time in 1929, moved to the first place for 1930. The total membership, including associates, dropped off by nearly a half. Total hours flown were down about 11 per cent for 1929, but the number of airplanes in use increased by a quarter. During 1929 the planes owned by the clubs averaged about 300 hr. flying each, and during 1930 the figure dropped to 200.

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FATALITY rates in Canada are not strictly comparable with those of the United States, as the basic statistics are not presented in the same form. The curves of pilots killed per million airplane miles and of passenger fatalities per million passenger-miles are used as on page 156, but the Canadian data cover all classes of flying, whereas those for the United States were only for the transport routes. A separate curve has been plotted for the light plane clubs, and in that case the unit is of fatalities per 10,000 hr. of flying, roughly comparable to the million miles of the other curves.

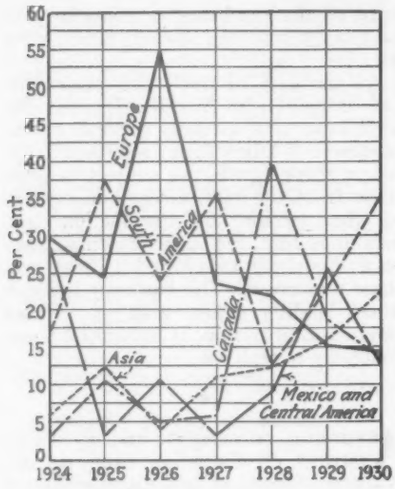
Allowing that the average pilot flies 100 hr. a year, the pilot curves can be taken as giving the percentage death rate among Canadian pilots. It will be observed that it runs just around 2 per cent, practically at the same level as for the average of all American pilots (see page 156). There has been steady though slow reduction of pilot hazards, and during the year just ended notable improvement was made both in the passenger figure and in the record of the light plane clubs. One fatality per 7,000 hr. of flying, among amateur pilots of all degrees of skill, who in many cases are able to get very little practice, is an excellent record by existing standards.

FOREIGN TRADE

THROUGH fair industrial weather and foul, the proportion of the products of the American aircraft industry that goes abroad has been steadily increasing. Measured by total value, and including both military and commercial production, and parts as well as complete airplanes and engines, about 5 per cent of our total production went abroad in 1927, 7 in 1928, 11 in 1929, and 17 per cent last year. Measured in numbers of planes, the proportions of combined civil and military production going abroad in the four years were 2.5, 3.5, 6, and 10 per cent. Relative to its total output, there are few classes of manufacture in the United States which must regard export trade as so important as in the aircraft industry, and furthermore export trade appears to be an excellent fly-wheel for the industry, for its rate of growth is, and has been ever since 1925, exceptionally steady. Even under the shocking conditions of last year, facing a world-wide financial and industrial collapse, export trade dropped off less than 6 per cent.

Although the total volume of exports has expanded at a comparatively constant rate, there has been a constant shift both in the geographical distribution of the trade and in the type of material that enters into it. Some idea of the change in nature of the business is given by the curve on page 170.

Up through 1926, the exports of planes were largely surplus war material, and those of engines almost exclusively Liberties. Average unit values were extremely low, never exceeding $2,200 for a power plant, and unit shipments were sometimes large. In 1927 several things happened. The American industry greatly expanded its facilities, and became interested in finding export markets for newly increased production. A succession of notable trans-Atlantic flights with American equipment gave our airplanes and engines a magnificant advertisement in foreign markets. A general arousal of popular enthusiasm for aviation created new markets in all parts of the world. Finally, but by no means of least importance, the Department of Commerce stepped into the regulatory field, and by strict supervision of design and construction annihilated once and for all any notion that American aircraft were shoddy and subject to flaws. Some such idea had been widely entertained abroad,

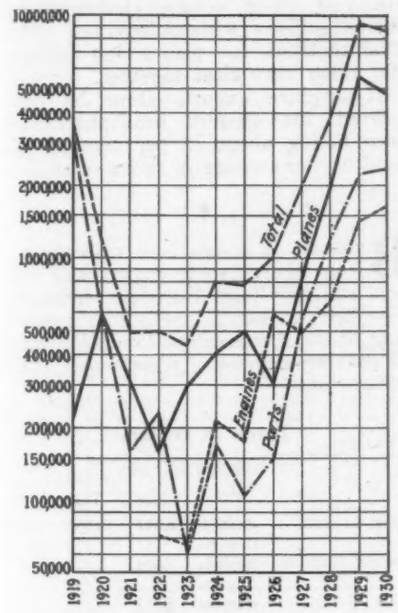


Aeronautical Exports, Continental Distribution

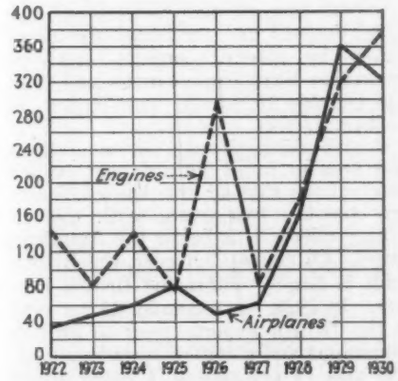
Aircraft Exported from United States

	1926		1927		1928		1929†		1930†		Total 1926-1930	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Europe	**2**	**12,650**	**5**	**45,075**	**9**	**121,428**	**15**	**252,944**	**11**	**142,861**	**42**	**574,958**
Belgium	..	.....	2	28,000	1	4,183	..	.....	..	.....	3	32,183
Germany	..	.....	..	.....	1	5,500	1	7,500	..	.....	2	13,000
Italy	..	.....	..	.....	2	84,950	5	99,219	1	10,800	8	199,969
Netherlands	..	.....	3	17,075	..	.....	3	16,000	..	.....	6	33,075
Switzerland	..	.....	..	.....	2	4,532	..	.....	..	.....	2	4,532
United Kingdom	2	12,650	..	.....	3	22,263	3	77,080	7	123,718	15	235,711
Canada	**9**	**6,116**	**26**	**197,021**	**62**	**685,712**	**80**	**799,353**	**63**	**673,776**	**240**	**2,361,978**
Mexico and Central America	**11**	**79,838**	**5**	**32,513**	**30**	**317,114**	**108**	**1,846,816**	**63**	**565,500**	**217**	**2,841,841**
Guatemala	..	.....	..	.....	3	36,400	4	10,000	2	4,032	9	50,432
Honduras	..	.....	1	8,350	1	9,000	3	22,761	..	.....	5	40,111
Panama	..	.....	..	.....	1	23,844	7	112,353	10	73,044	18	209,241
Salvador	1	4,188	..	.....	..	.....	3	27,840	..	.....	4	27,840
Mexico	9	73,650	1	10,001	20	190,133	85	1,624,501	45	445,626	160	2,343,911
Bermudas	1	2,000	..	.....	1	2,850	..	.....	1	6,000	3	10,850
Cuba	..	.....	3	14,162	4	54,887	5	46,836	5	36,858	17	152,743
South America	**15**	**147,173**	**19**	**406,615**	**35**	**340,452**	**90**	**1,647,083**	**107**	**1,947,150**	**266**	**4,548,473**
Argentina	6	29,038	1	8,875	5	55,052	25	375,693	20	233,871	57	702,529
Brazil	1	50	1	16,239	5	66,340	11	184,951	21	510,234	39	777,814
Chile	1	28,000	7	187,500	..	.....	40	721,750	17	355,090	65	1,292,340
Colombia	..	.....	2	63,890	1	19,250	1	60,000	2	33,350	6	176,490
Ecuador	..	.....	..	.....	..	.....	5	187,237	..	.....	5	187,237
Peru	7	90,085	8	190,111	24	199,810	7	115,652	45	794,654	91	1,390,312
Asia	**4**	**29,578**	**4**	**89,735**	**18**	**238,075**	**57**	**1,013,730**	**67**	**1,324,223**	**150**	**2,695,341**
China	..	.....	..	.....	9	102,175	24	528,741	41	935,472	74	1,566,388
Hong Kong	..	.....	..	.....	..	.....	11	104,600	10	71,064	21	175,664
Japan	..	.....	2	49,112	3	63,000	17	291,767	14	301,687	36	705,566
Philippine Is.	4	29,578	2	40,623	2	34,500	5	88,622	1	7,500	14	200,823
Siam	..	.....	..	.....	4	38,400	..	.....	..	.....	4	38,400
Oceania	**4**	**5,210**	**3**	**17,441**	**8**	**56,872**	**4**	**14,566**	**8**	**160,000**	**27**	**254,089**
Australia	4	5,210	3	17,441	7	50,872	1	3,600	..	.....	15	77,123
French Oceania	..	.....	..	.....	1	6,000	1	7,000	..	.....	2	13,000
Miscellaneous*	5	22,584	1	168	..	.....	7	73,366[2]	2	6,097[1]	15	102,215
Total	**50**	**303,149**	**63**	**848,568**	**162**	**1,759,653**	**361**	**5,647,866**	**321**	**4,819,661**	**957**	**13,378,895**

*Miscellaneous figures cover all continents, except in 1929 and 1930. †Exports to countries not given in break-down are included in continental totals. [1]Union of South Africa. [2]Hawaii



Aeronautical Export Trade, Total and by Sub-Divisions



Numbers of Airplanes and engines shipped abroad

Aircraft, Engines and Parts Exported

(Total Value in Dollars)

	1926	1927	1928	1929	1930	Total 1926–1930
Canada and Newfoundland	**50,061**	**448,475**	**1,403,873**	**1,764,104**	**1,209,260**	**4,875,773**
Mexico and Central America*	**114,535**	**90,381**	**419,656**	**2,400,402**	**1,126,804**	**4,151,778**
Guatemala	.....	211	37,917	17,200	13,348	68,676
Honduras	793	14,888	11,253	29,317	60,184	116,435
Mexico	85,459	34,458	236,068	1,851,733	609,015	2,816,733
Nicaragua	17,820	.....	990	7,368	4,241	30,419
Panama	30	4,824	46,699	316,650	273,717	641,920
Salvador	4,885	.....	.....	30,666	4,243	39,794
Bermudas	2,000	.....	2,850	4,575	6,000	15,425
Cuba	3,477	25,176	79,321	93,373	116,193	317,540
Dominican Republic	71	10,623	.....	2,756	1,101	14,551
Porto Rico	.....	.....	4,558	31,903	.....	36,461
South America*	**234,776**	**671,232**	**477,772**	**2,133,986**	**3,115,015**	**6,631,881**
Argentina	32,869	19,399	93,866	507,885	464,577	1,118,596
Brazil	6,544	17,899	113,226	249,094	702,799	1,089,562
Chile	56,030	222,448	17,443	790,395	692,564	1,778,880
Colombia	11,439	67,904	29,732	106,863	55,036	270,974
Ecuador	.....	.....	.....	188,267	.....	188,267
Peru	122,224	343,217	223,505	283,543	1,126,300	2,098,789
Venesuela	5,670	365	.....	17	38,539	44,591
Uruguay	.....	.....	.....	1,800	2,042	3,842
Europe*	**568,107**	**452,075**	**807,028**	**1,431,721**	**1,287,818**	**4,546,747**
Belgium	.....	99,103	14,183	34,660	31,878	179,824
Czechoslovakia	.....	4,848	3,890	1,096	2,062	11,896
Denmark	.....	120	19,345	2,769	175	22,409
France	3,450	5,475	7,526	69,162	21,950	107,563
Germany	11,016	80,369	208,558	417,940	261,655	979,538
Italy	3,020	3,498	99,834	134,383	44,968	285,703
Netherlands	25	19,977	83,195	120,641	162,552	386,390
Norway	250	2,080	1,925	9,733	.....	13,988
Poland and Dansig	.....	4,260	8,149	145,355	7,787	165,551
Soviet Russia in Europe	270,739	175,528	155,313	244,740	523,175	1,369,495
Spain	75	4,100	19,051	49,793	17,534	90,553
Sweden	7,038	.....	24,366	9,973	18,991	60,368
Switzerland	.....	10,000	5,482	20,360	6,622	42,464
Turkey in Europe	480	.....	.....	19,375	.....	19,855
United Kingdom	272,014	42,717	156,209	147,691	148,818	767,449
Asia*	**50,978**	**235,747**	**501,084**	**1,405,664**	**1,977,633**	**4,171,106**
China	.....	47,857	227,963	703,829	1,134,646	2,114,295
Java and Madura	.....	1,217	3,250	67	273,096	277,630
Hong Kong	.....	.....	6,162	15,960	75,683	97,805
Japan	675	77,819	136,078	448,056	439,915	1,102,543
Philippine Islands	29,578	41,247	88,130	161,120	19,727	339,802
Siam	20,345	38,000	39,501	36,501	3,321	137,668
Soviet Russia in Asia	.....	.....	.....	38,000	.....	38,000
Oceania*	**8,337**	**30,455**	**317,564**	**185,158**	**43,695**	**585,209**
Australia	7,186	30,455	55,138	19,956	43,204	155,939
Hawaii	.....	.....	256,426	122,694	.....	379,120
New Zealand	1,151	.....	.....	13,664	472	15,287
Africa*	**416**	**3,979**	.....	**20,834**	**42,410**	**67,639**
Miscellaneous†	.....	.....	.....	**4,637**	.....	**4,637**
Grand Total	**1,027,210**	**1,932,344**	**3,926,975**	**9,345,606**	**8,802,635**	**25,034,770**

*Total includes exports to miscellaneous other countries on the continent not included in break-down.
†Destination of these exports unknown.

and foreign competitors had been not at all loath to disseminate it.

In short, everything combined to open up new opportunities for the sale of newly built planes and engines, and in 1927 the average value per unit exported was more than twice what it had been in 1926, both for aircraft and for their power plants. There was a little drop in the average value of the engines the following year, corresponding to a lowering of prices in the United States, but on the whole there has been no substantial change in the figures from 1927 to the present day. The slight increase in the average value of the airplanes exported during the last two years has been due to the growing number of transport machines sent to the West Indies and Latin-America for use on the airlines there. The average values of the airplanes shipped abroad are now about twice as high as that of the machines produced for retention in the United States. That is not because export prices are set higher nor because of any extraordinary quality required in the exported machines, but because of the predominant rôle of transport planes and military planes, both very high priced, in the export figures. There have been relatively few shipments of two and three-passenger American planes to foreign countries. For Great Britain, on the other hand, the DH Moth and AvroAvian have been a mainstay of the export trade.

The rôle of war surplus, and especially of military orders for Liberty engines, is again suggested in the curve at the bottom of the second column. Engine shipments used to go up and down irregularly from year to year depending on the success that export brokers had in trading with some of the European and Latin-American governments for the sale of used military equipment. In 1926 a group of orders for Liberty engines raised the total number of engines shipped to a figure that was not beaten until 1929.

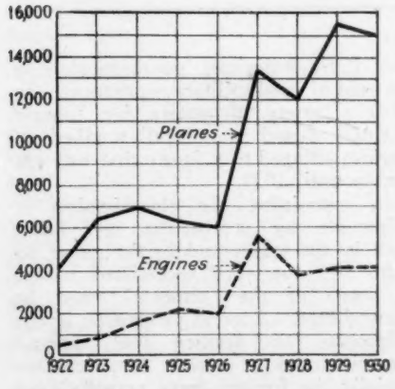
In examining the classification of shipments by destination, as shown both in the tables and in the curve on page 168, the very specialized nature of some of the "exports" must be remembered. A great proportion of the shipments to Mexico and Central America and to South America, especially the former, have actually been a transfer of equipment from one hand into the other, and the planes have remained in American ownership throughout. When an American com-

pany, operating an airline in Peru or Guatemala with American capital and largely with American personnel, ships airplanes to itself from the United States, they appear upon the export records, but it is scarcely rational to consider them as constituting foreign trade in the ordinary sense.

Taking that into account, the rapidly increasing proportion of our aeronautical exports that goes to South America is less impressive than it might otherwise be. For 1930 the southern continent took 35 per cent of our total shipments in value, a proportion only once exceeded in the past, and then only by virtue of the award of a large military order to an American company by one of the South American republics.

The proportion of shipments to Europe fell off again last year, for the fourth consecutive time, and the proportion to Asia increased, also for the fourth time running. It was, in fact, Asia that really came to the rescue of the American export records last year. South American shipments could be directly controlled in the United States, being paid for principally with capital raised in New York, but of the Asiatic countries that was true only to a very limited extent. Asia's total consumption of aircraft, engines, and parts from the United States ran more than a half a million dollars above that of any preceding year and nearly one and a half millions above any year before 1929. China was of course the largest consumer, but the Dutch East Indies and Japan both had a very substantial share.

Considering individual countries, and taking the records over two or three years to damp out the effect of one or two large orders, Canada appears as the best customer of the American aircraft industry, with Mexico, Peru, Chile, and China next in order of importance, and the Argentine, Brazil, Soviet Russia, and Japan coming along in the second division. In spite of the hostility of our State Department to the shipment of any sort of military supplies to Soviet territory, a hostility which has led to the cancellation of at least one important order for military aircraft, Russian trade forms a respectable part of the total. It is, however, of smaller relative importance now than it possessed in 1927 and earlier, when no native facilities for aircraft construction had been created, and when large numbers of engines were being taken from the United States. In 1926 Russia actually took 26 per cent of all American aeronautical exports, a proportion which dropped to a minimum of less than 3 per cent in 1929, and rose again to 6 in 1930. The Soviets play by no means an insignificant part in aeronautical trade, but certainly not a vital one.



Average Value (Dollars per Unit) of planes and engines exported yearly

A rather surprising feature of the export figures has been the small amount of business done with Australia and New Zealand, countries which have generally been among the best consumers of American manufactured products, as operating conditions there resemble those of our own prairie states much more closely than they do those of the United Kingdom. Australia and New Zealand take, for example, about 15 per cent of our annual exports of automobiles and about 8 per cent of the shipments of agricultural machinery, but they have been coming in for less than half of one per cent of the aeronautical exports. Although legal difficulties are partly responsible, and although the Australian government has offered heavy inducements to do business within the British Empire, still it seems that our trade with the British antipodes is disproportionately small and that there should be good opportunities for increasing it.

The distribution of exports among classes of commodities is of course also variable from one continent to another. For example, Europe still plays a large part in the total of aeronautical shipments, never having fallen below 14 per cent and averaging about 18 over the past five years, but the European consumption of completed American airplanes is almost negligible, only about four per cent of the total in number and in value. To put it another way, of our total aeronautical exports to Europe only about twelve per cent represent complete machines (not including their engines in the value), while the corresponding figure for Canada is about 50 per cent, and for South and Central America about two-thirds, and for Asia only a little less than that. Where aircraft and engines and a reasonable supply of spare parts are all being shipped together, it would be expected that the airplanes would account for about 60 per cent of the total value, not far from the condition that exists except in Europe. American shipments to that continent are made up principally of engines and accessories to be installed in European-built airplanes. Germany and the Netherlands are particularly liberal consumers of American engines, and of German imports from the United States over the last five years, totaling nearly a million dollars, barely one per cent has been under the heading of completed planes. Taking the world as a whole, however, engines shipped without planes are just about counter-balanced by planes shipped without engines. The total numbers for planes and engines run along very close together.

If airplane exports alone be considered, the western hemisphere has been taking about 75 per cent of the total on the average in recent years.

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BY WAY of comparison with American figures some export and import statistics from European countries have been garnered, mostly by the courtesy of the Aeronautics Trade Division of the Department of Commerce. The returns show:

Trade in Dollars

(Thousands omitted)

		1928	1929	1930
Great Britain....	Exports	6,467	10,539	9,980
" "	Imports	151	152	.....
France.....	Exports	5,600	8,577	.....
"	Imports	.....	130	.....
Italy.....	Exports	2,162	1,208	.....
Germany.....	Exports	1,269	1,682	.....
"	Imports	.....	55	.....
Netherlands.....	Exports	1,876	2,054	.....
"	Imports	1,018	850	.....

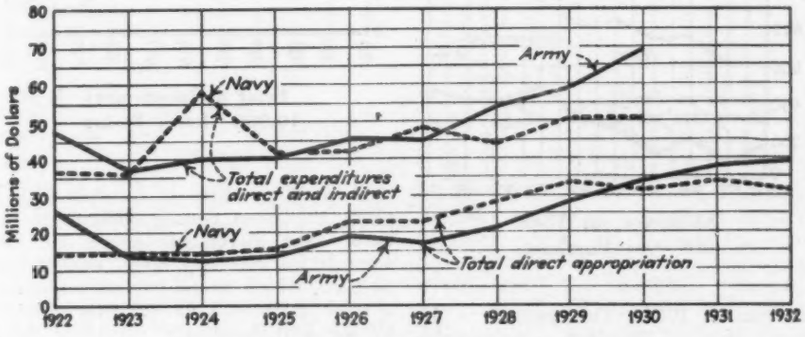
In the case of the Netherlands the large imports are accounted for principally by aircraft engines imported from other European countries and from the United States for installation in Fokker aircraft.

British foreign trade in aircraft is thus seen to run a little (about 10 per cent) above that of the United States over the last two years, while that of France falls a little below the American figure. Of course, however, the British trade is largely within the British Empire. In 1928, for example, 43 per cent of the British exports went to British Dominions and colonies, including Canada, and 14 per cent to Canada alone. In 1929 the corresponding figures were 52 per cent and 12 per cent. Exports to the United States amounted in the two years to 3 per cent and 7 per cent of the total, while Latin America received 13 per cent in each year. The residue, 41 per cent in 1928 and 28 in 1929, went to Europe outside the British Isles and to Asia, Africa, and Oceania outside the British Empire.

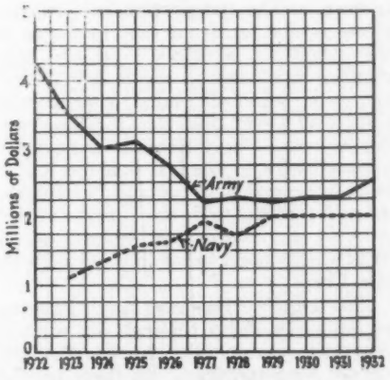
French exports are considerably increased by shipments for French lines operating in South America and eastern Europe. Aside from that, most of the French business is done in military planes.

British exports to Canada exceeded those of the United States by 33 per cent in 1928 and 59 per cent in 1929, and undoubtedly by an even larger proportion during last year. This apparently growing preference for British products is, however, probably more apparent than real, for a number of American firms have started factories or assembling plants in Canada within the past three years, and are playing their part within the Canadian industry rather than as exporters to a Canadian market.

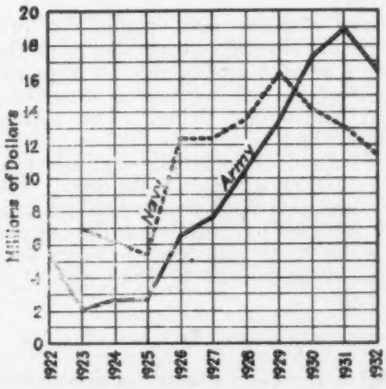
MILITARY AND NAVAL



Aeronautical Expenditures, Army and Navy



Appropriations for Experiment and Development



Money for New Planes and Engines

APPROPRIATIONS for the Army Air Corps and for naval aviation continue the tendencies of past years. The Navy got started with a rush upon the fulfillment of its five year program, and by 1929 was so well advanced, and it was so obvious that the program would be carried to completion on schedule, that appropriations for new equipment began to be cut. They have decreased in each of the last three years.

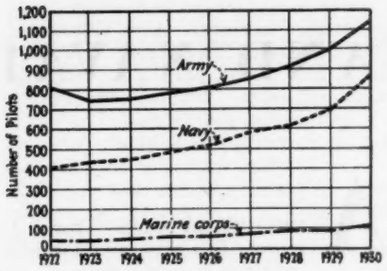
The Army in the meantime had been falling behind schedule, and as a result was given a steadily increasing appropriation for purchase of airplanes and engines. The budget estimate for 1932 shows the first drop in the Army's allocation for new equipment since 1923. For the third successive year, however, the Army grant for equipment is above the Navy's, although the Navy had had the larger sums available for seven years before.

The Army continues to receive a little more for experimental purposes than the Navy, and the War Department bill for 1932 shows some further increase under that heading. The Navy's allowance for experimental work continues at a flat $2,000,000, the level at which it has stood for several years.

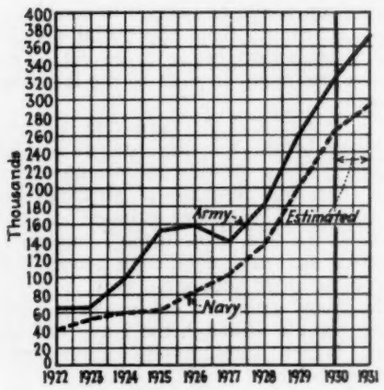
The largest change in the appropriation bills for 1932 is in the provision for new construction at Army Air Corps stations. That is almost twice what it has been in any previous year since the war.

	Army Air Corps						Naval Aeronautics					
	1927	1928	1929	1930	1931	1932†	1927	1928	1929	1930	1931	1932†
Appropriations—direct, total (incl. salaries of civil personnel)[1]	$17,107*	$21,598*	$27,681*	$33,713*	$37,236*	$38,685*	$22,556*	$27,087*	$33,218*	$32,913*	$33,768*	$31,821*
Appropriations—new planes and engines	$7,604*	$10,488*	$13,342*	$17,242*	$18,987*	$16,562*	$12,362*	$13,447*	$16,385*	$14,215*	$13,034*	$11,500*
Appropriations—experiment and research	$2,200*	$2,264*	$2,200*	$2,256*	$2,256*	$2,310*	$1,928*	$1,729*	$2,000*	$2,000*	$2,000*	$2,000*
Appropriations—new construction and improvements	$300*	$1,063*	$1,737*	$3,598*	$2,724*	$5,939*[2]	.....	$1,862*	$895*	$1,248*	$1,149*	$977*
Expenditures—total, direct and indirect	$45,225*	$53,868*	$58,771*	$69,012*	.....	.....	$48,282*	$44,143*	$50,502*	$50,787*	.....	.....
Total personnel at end of fiscal year:												
Officers	1,019	1,086	1,143	1,266	.....	.....	677	737	843	1,019	.....	.....
Enlisted men	9,275	10,311	10,921	12,086	.....	.....	4,425	11,421[6]	11,642	10,769	.....	.....
Flying personnel at end of fiscal year	846	908	992	1,133	.....	.....	649	695	776	964	.....	.....
Officer pilots, total	779	868	958	1,113	.....	.....	527	527	582	696	.....	.....
Naval	.....	.....	.....	.....	.....	.....	472	466	520	614	.....	.....
Marine Corps	.....	.....	.....	.....	.....	.....	55	61	62	82	.....	.....
Enlisted pilots, total	67	40	34	20	.....	.....	122	168	194	268	.....	.....
Naval	.....	.....	.....	.....	.....	.....	108	141	170	244	.....	.....
Marine Corps	.....	.....	.....	.....	.....	.....	14	27	24	24	.....	.....
Students graduated from flying schools during year	84	135	159	306	.....	.....	.....	113	107	234	.....	.....
Number of planes on hand[4]	1,213[5]	1,104[5]	1,151[5]	1,319[5]	.....	.....	807	946	979[5]	1,081	.....	.....
Airplanes purchased during fiscal year	315	491	432	418	475[5]	.....	297	313	423	.....	.....	.....
Flying hours during fiscal year	140,909	182,903	263,381	325,273	370,000†	.....	103,391	137,289	203,198	264,788	288,000†	.....
Reserve officers enrolled and qualified as pilots	3,699	3,545	3,161	1,845	.....	.....	.....	.....	.....	.....	.....	.....
Reserve officers doing periods of active duty during year	1,273	2,243	1,404	1,415	.....	.....	.....	.....	.....	.....	.....	.....

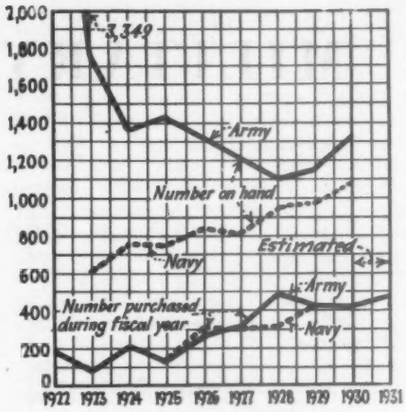
*Thousands omitted. †Estimates. [1]Excluding planes for Reserve Corps and National Guard up to 1930. [2]Including new construction of buildings (on which see note below). [3]This item previously carried as part of Air Corps Bill, but listed in 1932 under general army construction. [4]Actual date for these figures ranges from July 1 to Dec. 31, usually October 1. Both figures include Reserve planes. [5] June 30. [6]Increase largely due to commissioning of aircraft carriers Saratoga and Lexington.



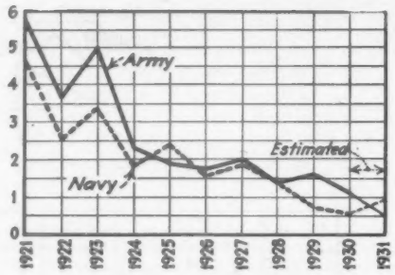
Army and Navy Pilots in Active Service



Flying Hours by Fiscal Years



Airplanes on Hand and New Purchases



Fatal Accidents per 10,000 Hours Flying

THE number of planes on hand for the Navy has risen during the past year to above 1,000, the level set in the five-year program bill of 1926. Not all, however, are "useful" within the meaning of that act. The Army's total is still about 25 per cent below the figure of 1,800 provided by its program.

Although considerable headway was made toward overcoming the personnel shortage in naval aviation during the past year, the number of Navy and Marine Corps pilots is still about 10 per cent below the number of planes. In the Army, on the other hand, there are about 15 per cent more planes than pilots reported.

Flying activities continue to expand steadily, and the accident rate is being reduced with equal steadiness. The Army gets about 20 per cent more flying time than the Navy, and this year the combined figure for the two services is close to 1,800 hours a day. In both services the accident rate has been roughly halved in the last three years. The Navy's safety record in 1930 was so spectacular that a continued annual improvement was hardly to be hoped for, but for the first six months of the year 1931 the Navy figure remained considerably better than for any year previous to 1929. This year it is the Army that is showing a remarkable jump in safety, and for the first time since 1925, the Army's fatality rate is definitely below that of the seagoing service.

The accident rates plotted on this page are directly comparable with the curve of pilot fatality rate on page 156 to show the relative hazard of military and commercial flying. The million miles which is taken as the basis in the one case is substantially equivalent to the 10,000 hours used in the other. The air transport pilot fatality rate per unit of operation has been below the average for the Army and Navy in every year since 1921, usually by from a third to a half.

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NO European country publishes data on military operations with anything like the same completeness as characterizes the reports of the United States Army and Navy. For a number of countries, in fact, it is impossible to get any information at all, but a few partial figures have been secured, some of them official releases by the governments concerned, others unofficial approximations. Most governments are particularly loath to give any accurate information on the amount of flying done, but the total of hours for the Royal Air Force during 1930 has been credibly estimated at 300,000, that for the French air force for about 250,000, and that for the Dutch Army and Navy for about 35,000. Official releases show about 5,000 flying hours last year for the Danish air force, 17,400 for that of Sweden. On the basis of those figures, the American Army and Navy are getting more flying time than the forces of any other two countries combined.

Data on numbers of aircraft and of pilots are about equally difficult to secure. The Royal Air Force had 790 aircraft in the "first line" at the end of 1930, which would probably indicate a total of about 1,800 machines owned by the British service, including those used for training. The Royal Air Force has 2,400 qualified pilots among the commissioned officers and 316 enlisted pilots, with 1,136 qualified pilots in the reserve. The proportion of enlisted pilots is not far from that in vogue in the American services. Of the total number of officers in the R.A.F. 73 per cent are qualified pilots, a proportion somewhat lower than that for the Army Air Corps. The difference is no doubt accounted for by the fact that the R.A.F. is an independent force and has its own ground services to do for it certain work done in this country by bureaus of the War Department not connected with the Air Corps.

The Dutch Army and Navy have approximately 280 airplanes, while in the Swedish service the number of planes cannot be determined, but there are 534 qualified pilots, including reserves. France and Italy give out no figures whatever, but indirect evidence indicates that France has about 2,800 serviceable military airplanes (including training machines).

Accident information is still harder to find, but an official report on the number of accidents and number of fatalities is freely made by the Royal Air Force. Based on the assumed total of flying hours already given, the British total of 46 fatal accidents in the service during 1930 appears to amount to about 1.5 fatal accidents per 10,000 hours, or about 70 per cent higher than the recent average for the American Army and Navy. France is reported to have 67 fatal accidents in military and naval aviation in 1929, a rate of about 2.8 per 10,000 hours. There is no year-by-year report for Japan, but the average fatal accident rate there from 1921 to 1929, inclusive, is given as about 2.6 per 10,000 hours,—an exceptionally low figure over that period. The volume of flying activity worked up to about 100,000 hours a year by 1928. The Swedish operations are of course hardly extensive enough for a single year's figures to give a useful average, but for the last year the fatal accident rate in Swedish military aviation was 1.14 for every 10,000 hours.

Fatal Accidents Per 10,000 Flying Hours

	Fiscal Years									
	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931
Army	3.68	5.02	2.35	1.93	1.71	1.99	1.37	1.59	1.14	*0.59
Navy	2.76	3.42	1.87	2.35	1.56	1.84	1.38	0.89	0.53	*0.90

*First 6 months.

FOREIGN ACTIVITIES

Foreign Subsidies and Appropriations

(Thousands of Dollars)

Country	Year	Direct Transport Subsidy	Total for Civil Aeronautics	Total for all Aeronautics
North America				
Canada	28–29	....	3,345[1]	5,042
	29–30	....	3,658[2]	5,605
	30–31	....	3,987	.....
South America				
Mexico	28–29	....	.....	362*
Argentina	29–30	....	858	.....
Europe				
Austria	30–31	325	500	.....
Belgium	28–29	170	595	7,245
	29–30	445	1,430	11,430
	30–31	413	.....	.....
Czechoslovakia	29–30	350	993	2,743
	30–31	540	1,075	3,695
Denmark	29–30	93	357	570
	30–31	93	.....	402
Finland	28	....	.....	582*
	29	13	.....	758*
	30	47	47	.....
	31	....	50	.....
France	28–29	4,500	8,520[3]	.....
	29–30	6,890	7,316	42,516
	30–31	8,040	9,291	78,191
	31–32	8,400	9,400	79,000
Germany	29–30	4,650	10,640[4]	10,640
	30–31	4,530	10,460	10,460
	31–32	....	10,240	10,240
Great Britain	28–29	1,300	2,761	96,000[5]
	29–30	1,660	2,763	95,300[5]
	30–31	2,080	3,386	101,800[5]
Greece	28–29	....	.....	168*
Hungary	29–30	....	35	.....
	30–31	....	35	.....
Italy	28–29	2,530	2,600	36,750
	29–30	2,750	3,140	36,750
	30–31	....	.....	37,700
Jugo-Slavia	28–29	88	98	3,260
	29–30	70	108	.....
Netherlands	28	240	326	1,300
	29	370	482	1,355
	30	400	598	1,571
	31	499	.....	.....
Poland	28–29	....	729	2,819
	29–30	147	.....	2,600*
	30–31	147	.....	.....
Roumania	28–29	197	.....	.....
	29–30	....	.....	1,530*
	30–31	325	228	.....
Russia	29–30	....	.....	16,425
Spain	28–29	....	.....	3,590*
	29–30	212	.....	9,330*
Sweden	29–30	134	168	2,308
	30–31	160	205	2,675
	31–32	160	219	.....
Switzerland	28–29	40	.....	375*
	29–30	71	.....	381*
	30–31	77	.....	.....
Turkey	29–30	....	.....	632
Africa				
S. Afr. Union	28–29	39	39	671
	29–30	39	39	660
Asia				
India	28–29	....	193	8,507
	29–30	128	865	4,815
Japan	28–29	290	.....	.....
	29–30	1,360	2,270	.....
Oceania				
Australia	28–29	338	486	2,166
	29–30	....	1,220	3,300
New Zealand	28–29	....	.....	211*
	29–30	....	36	294

*Military only. [1] Also $400,000 paid to air mail contractors. [2] Also $1,200,000 paid to air mail contractors. [3] For this year only including expenses of technical, meterological services, etc. [4] Including supplementary budget and allowance for effect of a loan to hufthausa, later to be paid off by the government. [5] Including appropriations in aid from other departments than the Air Ministry.

A COMPARISON of aeronautical expenditures has been made in tabulated form, but it requires some little explanation. There are many gaps which could not be filled even after study of all the records available in this country. It is impossible to secure strictly comparable figures for parallel listing for the various countries. The definition of the term "subsidy" varies from place to place. Still more variable is the determination of what should be included within the appropriations for civil aeronautics. In France, and in a number of other countries to a lesser extent, there are general services which have both civil and military functions and which can not be split up between the two.

In general, the attempt has been to include charges for the regulation of aircraft, for airway development, and for research bearing exclusively on civil employment of aviation. In short, the items have been set as nearly as possible in parallel form with those of the budget of the Aeronautics Branch of the Department of Commerce. It is not always possible to make such a separation, however, and in some cases meteorological services and other auxiliary expenditures are included. Very special cases are those of Germany and Austria, which are prohibited by treaty from having any military air force, and which must, therefore, charge all their aeronautical expenditures to the civil division. In Germany a large amount of miscellaneous research, developmental, and administrative work that would be carried in any other country by the Army or Navy has to go down as civil expenditure.

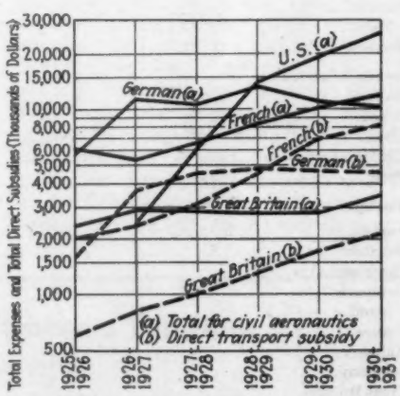
The factor of purchasing power of money has a less serious effect on the comparability of these budgets than it did a couple of years ago—practically all currencies now being stabilized, and violent fluctuations in purchasing power having disappeared.

To show what the several countries are getting for their money in the way of air transport operation, the curves at the bottom of the page have been drawn.

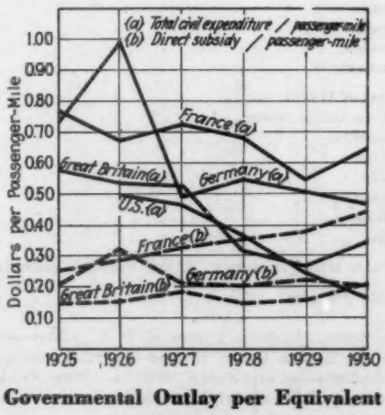
Both the direct subsidies to the transport companies and the total expenditures on civil aeronautics have been plotted. The figures used do not exactly correspond to those in the table in some cases, as a certain proportion of the aeronautical expenses of non-aeronautical departments, and particularly those for meteorological service along airways, have been counted in. In the case of the United States the figure plotted as the total governmental outlay on civil aviation includes the appropriations of the Department of Commerce, the Post Office Department's deficit on air mail, and the Weather Bureau's airway work.

Total expenditures of course have little significance unless they are considered in terms of population, or area, or wealth, or volume of activity.

In the lower curve both direct subsidy and total civil aviation expenditure are given in terms of dollars per equivalent passenger-mile of traffic, taking a ton-mile of express or mail as equal to ten passenger-miles. It is the traffic actually handled, not that for



Total Expenditures on Civil Aeronautics, and Subsidies



Governmental Outlay per Equivalent Passenger-Mile

which capacity is provided, that is used in its calculation—so that if it appears that the government is spending 50 cents per passenger-mile on civil aviation where the passenger fare is only five cents, the contribution of the government is ten times that of the patrons. In the past it has been conventional to reduce these subsidies to dollars per mile flown for purposes of comparison, but transport airplanes vary widely in size, and that course was somewhat unfair to the large machine.

The French and German contributions to civil aviation vary relatively little from year to year, the former running at about 60 cents and the latter at about 50 cents per passenger-mile, with direct subsidies of 40 cents and 20 cents respectively. The curve for the United States, and to a somewhat lesser extent that for Great Britain, shows steady progress towards self-support. In 1926 the direct contribution of the government to American civil aviation as expressed by the transport lines was 50 cents per equivalent passenger-mile, or $5 per ton-mile. In 1928 it was down to 37 cents, and now it has dropped below 17. In the meantime, the British figure had been running along very closely parallel to the American one, or in general a trifle higher, until last year. In 1930 it turned up to 34 cents per equivalent passenger-mile, from a minimum of 27 in 1929. In other words, in proportion to the amount of transport operation the government of the United States is spending just about one-half as much as the least liberal of the three European nations leading in transport flying, and the gap between our own figures and the European ones is widening. Although no curves have been drawn for Italy and the Netherlands, their expenditures have been calculated for the single year 1930. For Italy, the result is roughly 40 cents per equivalent passenger-mile, between Great Britain and France. The Netherlands, with comparatively little pioneer airway construction to do at government expense, make the best showing of all—seven cents spent on civil aviation for every passenger-mile in 1930. The operations of the K.L.M. have of course long been famous for economy, and the line has frequently been quoted as more truly "commercial" than any other in Europe.

Annual Airplane Mileage in Air Transport

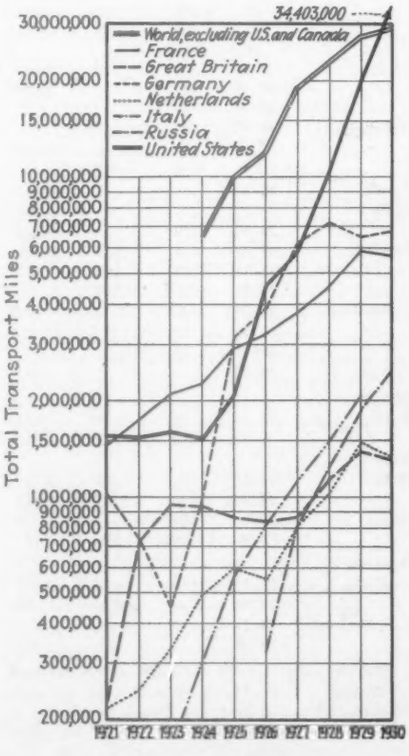
(Thousands Omitted)

	1926	1927	1928	1929	1930
North America					
Canada	....	....	182	491	1,000[7]
Mexico[1]	....	....	490	965	....
Panama	....	....	....	89	....
South America					
Bolivia	....	36	94	120	....
Brazil	....	14	280	327	....
Chile	....	....	....	192	350
Colombia	304	330	581	765	....
Peru	....	....	136	....	....
Europe					
Austria	8	243	400	421	....
Belgium[2]	187	238	394	500	....
Czechoslovakia	152	258	460	564	....
Denmark	127	92	92	96	....
Finland	58	64	121	138	....
France[3]	3,240	3,751	4,534	5,850	5,700[7]
Hungary	....	....	93	79	....
Germany	3,900	6,190	7,110	6,470	6,719
Great Britain[4]	840	873	1,136	1,386	1,286
Italy	325	815	1,236	1,869	2,500[7]
Jugoslavia	....	....	92	118	....
The Netherlands[5]	555	814	1,023	1,495	1,348
Poland	532	672	667	884	860
Portugal	....	35	35	15	....
Russia	815	1,127	1,483	2,078	....
Spain	....	80	180	406	....
Sweden	212	204	200	126	133
Switzerland	195	196	330	364	262[7]
Rest of World					
Africa, British South	....	....	....	55	....
Australia	417	423	513	685	....
China	....	....	....	....	....
India	....	....	....	....	....
Japan	....	545	532	541	....
Persia	....	120	210	480	....
Siam	....	61	51	45	....
Whole world outside U. S. and Canada (estimated)	**11,870**	**18,850**	**22,800**	**27,500**	**29,000**
United States[6]	**4,429**	**5,810**	**10,472**	**20,243**	**34,400**

[1]Mexico—Excludes holders of U. S. mail contracts. counted under U. S. [2]Belgium—Includes lines in the Belgian Congo [3]France—Includes numerous lines in Africa and South America. [4]Great Britain—Includes line across Asia to India. [5]The Netherlands—Includes lines in and to Dutch East Indies. [6]Includes U, S, operated lines in Mexico, and Central and South America. [7]Approximated from partial returns.

OUTSIDE of the United States, the general volume of air transport operation and traffic show only a relatively slow change. Most of the leading European states, and especially France and Great Britain, are at the same time spreading out their activities and concentrating. They are spreading geographically, but concentrating upon a few main lines. So it appears from the preliminary figures that in both of those countries there was a slight drop of mileage in 1930, as compared with 1929, yet in both cases new lines of inter-continental scope were being operated. In France the volume of traffic increased by from 10 to 15 per cent in the last year. In Germany there has been practically no change since 1927 in total magnitude of operations. Great Britain has been virtually static, so far as these simple totals express the condition, for three years, all British effort having been concentrated on preparation of new Empire air routes, such as the one to South Africa. Italy continues to develop rapidly, having made about 40 per cent average gain during 1930. The Dutch lines, like most of those of the small European countries, show advances of 20 per cent or less. Nowhere else is there anything to match the development in the United States, where the average gain on mileage and on traffic has been about 80 per cent over 1929 and about 300 per cent over 1928. The operations of five European countries, France, Germany, Great Britain, Italy, and the Netherlands, make up about 70 per cent of the total for the world outside of the U. S.

In 1930, for the first time, the transport mileage in the United States, and



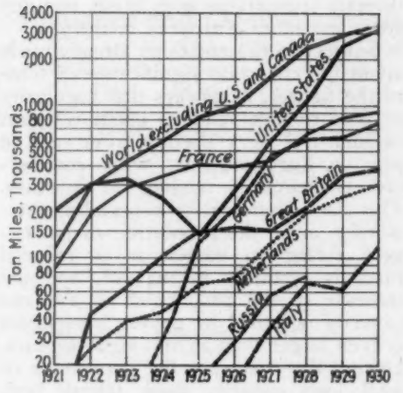
Air Transport Mileage Year by Year

Passenger Traffic in Passenger-Miles

(Thousands Omitted)

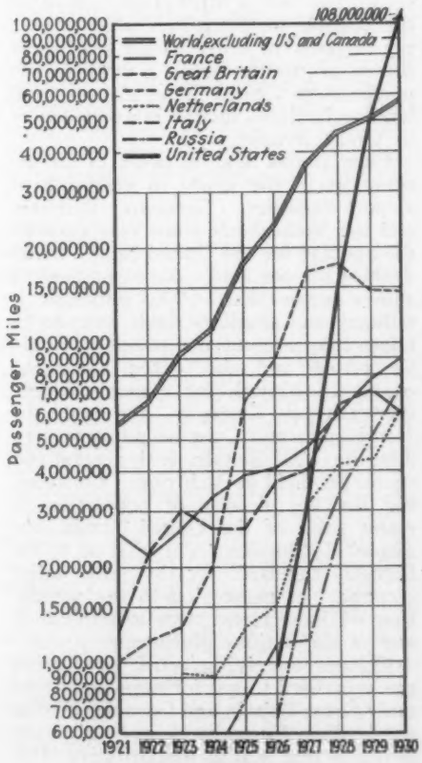
	1926	1927	1928	1929	1930
North and South America					
Canada	....	....	422	690	988
Colombia	653	798	1,300	1,552	....
Mexico	....	....	....	510	....
Europe					
Belgium (including Congo)	....	....	....	637	....
Czechoslovakia	205	508	750	1,422	....
Denmark	....	....	....	313	....
France	4,090	4,795	6,160	7,750	9,170*
Germany	9,090	16,720	17,820	14,775	14,660
Great Britain	3,746	4,296	6,476	7,127	6,011
Italy	657	1,997	3,485	5,295	7,500*
Netherlands	1,540	3,220	4,220	4,355	6,400
Poland	1,270	1,427	1,343	2,388	2,020
Russia	1,150	1,170	2,690	....	....
Spain	....	....	....	725	....
Sweden	....	....	....	720	....
Switzerland	....	....	....	761	668*
Rest of World					
Australia	....	412	545	1,532	....
Japan	....	....	....	470	....
Whole world outside of U. S. and Canada	**22,700**	**36,000**	**45,800**	**50,300**	**57,200**
United States	**983**	**3,400**	**15,350**	**48,000**	**108,000**

*Approximated from partial returns,



Express and Mail Traffic in Ton Miles Year by Year

also the passenger traffic, exceed the total for all the rest of the world as well as it could be estimated. In the case of passenger traffic the margin is a very handsome one indeed, the United States having almost two-thirds of the world's total volume. Rather curiously, since America was the country of air mail pioneering, the express and mail traffic were relatively much less important here in 1930 than the passenger business, and the total volume of American express and mail business, in ton-miles, was about 7 per cent less than for Europe and the rest of the world. Eight or nine years ago there was more air mail and express activity in North America than everywhere else put together, but in recent years there has been a relatively more rapid gain in Europe than in the Western Hemisphere.



Passenger Mileage Year by Year

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THE figures on regularity and reliability of service, on frequency of forced landings, and on "commercial efficiency" as shown by the proportion of the available space in the cabin that is occupied by passengers, that were given in last year's statistical issue are being omitted this time. The methods of calculating such factors as regularity vary so widely among the different countries that comparisons are likely to prove misleading or unfair. The same is true of "commercial efficiency," for in some countries a very large number of passengers are carried on passes, and counted among the total traffic. As for frequency of forced landings, it has been called to our attention by the officials of Imperial Airways that the figures given under that heading last year for British aviation really pertain to the total of unscheduled landings. They included trips on which the machine returned to its starting point because of weather, and were not limited to forced landings in the ordinary sense. The average for Imperial Airways during 1930 was one actual forced landing, outside of a regular flying field and due to mechanical reasons, on every 189,514 miles on European services, one for every 529,000 miles from the route to India. There are no American figures

Express and Mail Traffic in Ton-Miles

(Thousands Omitted)

	1926	1927	1928	1929	1930
North and South America					
Canada	....	....	56	98	313
Colombia	60	70	93	144	....
Mexico	....	....	....	38	....
Europe					
Belgium	....	....	....	66	....
Czechoslovakia	4	11	14	96	....
Denmark	....	....	....	9	....
France	398	431	639	824	910*
Germany	213	467	598	625	765
Great Britain	159	153	215	345	378
Italy	11	36	70	63	120*
Netherlands	74	125	194	251	304
Poland	26	35	40	45	67
Russia	28	57	76	....	....
Spain	....	....	....	6	....
Sweden	....	....	....	20	....
Switzerland	....	....	....	27	19*
Rest of World					
Japan	....	....	....	3	....
Whole World outside of U. S. (estimated)	**980**	**1,530**	**2,330**	**2,870**	**3,320**
United States	**271**	**575**	**1,082**	**2,458**	**3,150**

*Approximated from partial returns.

directly comparable with these, nor any from any other European country.

Subject to the notations already made about the uncertain significance of some of the figures, it appears that regularity of performance remains about constant or improves very slightly from year to year on European lines, while commercial efficiency is tending to increase. This last tendency is especially noteworthy, since the proportion of passengers riding on passes or at reduced rates is certainly falling off, and the increase in the proportion of airplane capacity occupied by paying passengers is even larger than at first sight appears. During the past year the percentage of total load capacity used, taking both passengers and freight and mail capacity into account, was 58 per cent on the European services of Imperial Airways, 54 on the German lines, and was very close to 50 per cent on both the Dutch and British operations to southern and south-eastern Asia.

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WE naturally look first at the table of airports, airplanes, and licensed pilots in the various countries of the world to see how the figures for other lands compare with those for the United States. There is nothing to disturb us in the comparison. The United States and Canada are not so far beyond all competition with the rest of the world in aeronautical development as they are in the manufacture and use of highway motor vehicles, but we are still well ahead of all rivals. The United States alone has almost four times as many automobiles as all the rest of the world outside of Canada. For civil airplanes, the ratio is two to one instead of four to one. For qualified civil pilots almost exactly the same ratio holds, more than two-thirds of the world's licensed pilots being in the United States and Canada. Curiously enough, the proportion is still the same for civil airports, the English-speaking countries of North America again having just a little over two-thirds of the world's supply.

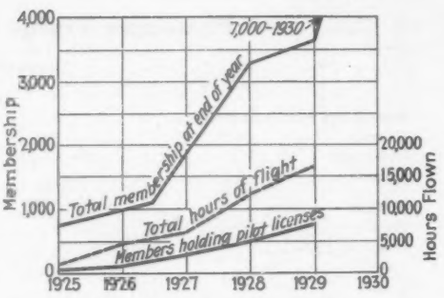
Turning to the comparison of individual countries, it is surprising to find that the largest number of civil planes is licensed in France, for the French people have not had the reputation of being great users of aircraft of private ownership. An explanation is found in the lavish equipment of French transport lines, and especially those operating outside of France. The planes in use by the French transport companies outnumber, by nearly two to one, the total for all the other transport lines of Europe, and they outnumber by just a third the transport planes in the United States, where there is approximately six times as much operation as in France.

Germany is second in order, Great Britain third, and Italy fourth on total numbers of planes. On per capita ownership France still leads, with Great Britain second and Germany third among European countries, but none of them reach the standard of the United States, Canada, or Australia. Per capita ownership in the United States, in fact, is about three times as high as in any European nation.

It is rather interesting to compare figures for airplanes in service with those for automobile registration. That is, perhaps, the best indication of the relative degree of acceptance of the airplane, with or without direct government encouragement, for it takes into account such factors as national wealth and the mobility of the population. Where a people buy automobiles but do not buy planes, there is something fundamentally wrong either with the attitude of their government or with the efforts that have been made to exploit their aeronautical market.

In the United States there are approximately 2,400 automobiles for every airplane. In Canada the ratio is 2,100. In France, thanks to generous government support of the transport lines, it is only 870, in Germany 500, in Great Britain 1,100, in Italy 270. In Japan it stands at 300, lower than any other large country except Italy, and in Australia 2,000. It is rather surprising to find that the ratio of airplanes to automobiles is highest in the European countries, where surface transportation is very well organized and where most travel is over comparatively short distances within the easy scope of a highway vehicle. That it is so, in spite of the inherent difficulties with which flying has to contend, reflects both the effect of liberal government support of private flying and a very general air-mindedness, of a very practical form, among sportsmen. The records made in Germany and Great Britain are particularly remarkable, since in those countries there is no direct governmental assistance to private ownership.

The pilot figures by individual countries present little of novelty. Taking the world as a whole, it is the general rule that the pilots exceed the civil planes in number by 50 to 100 per cent, the apparent surplus of pilots in the United States being just about equal to the average for the rest of the world. No German statistics can be obtained, but aside from that the principal European countries rank in the same order as on plane licensing. The low figure for Italy is probably explained by the use of a great proportion of the country's civil aircraft by reserve officers, who do their flying in semi-military status and do not need to hold civil licenses.



British Light Plane Club Development

Discussion on p 177

Although the municipal airport movement was just started in Great Britain within the past couple of years, and although British municipalities have not raised money by borrowing for airport purposes with any such freedom as has been common in the United States, the country is already very well supplied with airports in proportion to its area. Of course the British Isles are so thickly settled that only a small proportion of all the possible municipalities need to supply airports in order to get one every fifteen or twenty miles. Only in the northeastern United States are prepared landing facilities spotted in as thickly as in Great Britain.

Cuba stands next in order of all the countries of the world in profusion of airport facilities. Germany, Belgium, and the Netherlands come very close to the average for the United States, about 2,000 sq.mi. per field. No other country shows better than 4,000, although if military and auxiliary fields were to be taken into account the standard would be raised and the order somewhat changed. France, for example, would then outrank Germany, and both the Netherlands and Cuba would come very close to Great Britain, with around 600 sq.mi. per field in each case. Considering the low density of population in many parts of the United States, our airport development is at least up to the highest standard set by any other country. In proportion to the population we have many more airports than any of the nations of Europe.

Figures on civil aircraft production are very hard to get for most countries. Only Great Britain and Germany among the leading European powers give out anything that is at all authoritative. For the rest of the world, except in a very few cases, it is necessary to depend on rough estimates or to take a single

Accidents

Discussion on p 177

	Passenger Fatalities per Million Passenger-Miles							Average Over Last 5 Years
	1924	1925	1926	1927	1928	1929	1930	
France	0.90	1.03	2.69	1.25	0.97	1.29	....	1.38
Germany	....	....	0.44	0.54	0.22	0.48	0.68	0.48
Great Britain	2.67	0.00	0.00	0.00	0.00	1.68	0.33	0.51
Italy	....	....	....	....	0.00	0.57	....	....
Netherlands	2.10	2.31	0.65	0.00	0.00	0.00	0.00	0.30*
United States	....	....	....	0.59	0.85	0.28	0.24	0.32**

*Seven years taken, to bring coverage up to 20,000,000 passenger-miles. (All other averages based on at east 25,000,000). **Four years only.

figure including both military and civil construction. Some of the figures for the smaller countries may be far afield, but they are the best that could be secured. It is at least clear that, outside of the United States, Great Britain is first among the producers of non-military aircraft, Germany second, and France third. That is of course a rating by numbers of machines built. The order might be somewhat modified if the total value of the production were used, but approximations to that would be even more difficult, in fact almost impossible, to secure.

The United States does not enjoy quite so high a relative standing on production of aircraft as on operation, but it still has a substantial majority, in fact about 60 per cent, of the world's total for 1930. Since the depression in the aircraft industry was more seriously felt in the United States than elsewhere or, to put it conversely, since the 1929 boom rose more quickly to a higher peak, our proportion of total civil production in 1929 would probably have been about 75 per cent.

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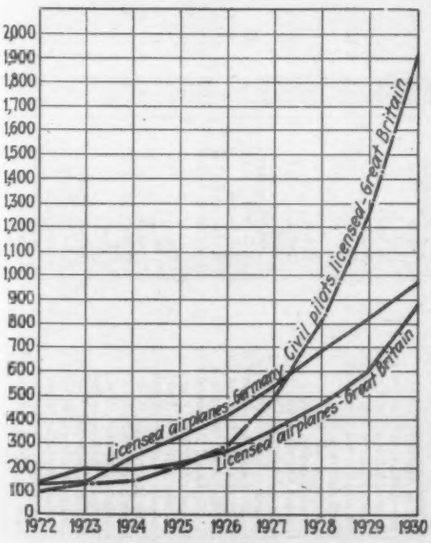
THE accident figures given in the table at the bottom of the opposite page are considerably amplified over those of a year ago, thanks to assistance from various official quarters, and especially to the industry of M. Henri Bouché, editor of *L'Aéronautique*, in collecting accident experience in French transport ever since the war. The averages have spread out considerably. A year ago the five-year records for Germany, Great Britain, and the United States were on almost an exact par. At the end of 1930, however, the United States has gained a good lead over both of those countries on the long-term average, and a still better one over France. The figure for the Netherlands over seven years average is slightly below the four-year return for the United States, a remarkably good record, but still one which covers only a very limited volume of operation. The Dutch airlines have gone on for the last four years with no fatal accidents at all, but the total passenger traffic during that time has been only about equal to the total for the United States during the last fortnight of 1930 and the first six weeks of 1931, in which period there have also been no fatalities here.



Airplanes and Pilots, Great Britain and Germany

Several of the smaller countries of Europe, including Poland and Sweden, report long periods of entire freedom from accidents, in some cases running back to the beginning of their air transport history, but the magnitude of their transport operation is too small to make it fair to take any averages for comparison with the figures of the great powers.

Although the accident rate obviously is not unconnected with the efficiency of the operations, it cannot be taken as a direct and exclusive measure of their quality. In some cases where there is a large amount of flying over sea or over desert or over jungle the opportunities for fatal crash are exceptionally great. French airlines, for example, probably work on the average under conditions more difficult than those of most other European countries.

World Distribution of Airports, Airplanes and Licensed Pilots

	Airports			Square Miles of Area per Civil Airport	Planes	Licensed Transport Service	Population per Airplane	Civil Pilots Licensed	Estimated Production of Civil Aircraft
	Civil	Auxiliary	Military		Total				
North America									
Canada	69	...	..	53,500	499	...	19,900	699	.....
South America									
Argentina	17	3	2	67,900	154	...	70,800	385	.....
Bolivia	18	...	17	28,100	20	9	148,000	.....	.....
Brazil	17	29	5	193,000	43	13	938,000	31	2
Chile	8	3	6	35,200	.....	23	.....	.....	.....
Colombia	3	...	1	161,000	17	15	469,000	.....	.....
Cuba	36	22	2	1,240	.....	...	.....	.....	.....
Mexico	31	62	7	24,800	42	...	390,000	157	.....
Peru	3	10	4	77,000	29	19	19,000	.....	.....
Uruguay	1	7	1	72,153	.....	...	.....	70	.....
Europe									
Austria	5	...	..	6,470	40	...	168,000	42	5
Belgium	5	...	9	2,350	131	...	61,000	.....	140*
Bulgaria	.....	...	..	.....	35	3	160,000	.....	.....
Czechoslovakia	6	...	13	9,040	89	29	161,000	.....	8
Denmark	3	3	3	5,700	6	...	573,000	.....	2
Finland	3	2	3	16,600	.....	5	.....	19	0
France	28	82	30	7,570	1,122	652	36,700	1,100	700*
Germany	95	...	..	1,900	984	182	62,340	.....	330.
Great Britain	129	...	47	730	875	22	50,500	1,955	575
Greece	4	...	..	12,300	.....	...	.....	.....	.....
Hungary	8	...	0	4,490	.....	14	.....	.....	.....
Italy	25	...	..	4,780	649	...	63,500	357	52*
Netherlands	5	6	8	2,640	40	...	191,000	68	.....
Poland	14	14	..	.....	91	23	333,800	67	62*
Rumania	5	9	7	24,500	.....	...	.....	.....	60*
Spain	.....	...	..	.....	81	...	277,000	.....	174*
Sweden	10	...	..	17,325	14	...	436,000	34	.....
Switzerland	.....	...	..	.....	67	18	60,000	124	25*
Africa									
South African Union	29	...	..	16,300	41	...	161,000	97	.....
Asia									
China	.....	...	..	.....	.....	13	.....	400*	.....
India	.....	...	..	.....	40	...	7,970.000	86	.....
Japan	7	21	17	21,200	196	...	290,000	263	.....
Australia	87*	118	..	34,200	245	...	25,880	397	.....
World (estimated)†	**720**	...	..	.....	**5,000**	...	**147,000**	**7,600**	**1,650**
United States	**1,475**	**177**	**67**	**2,050**	**9,818**	**400**	**12,500**	**15,280**	**2,521**

†Excluding United States and Canada. *Including military.

THE British light plane clubs have had a sharper increase in membership in 1930 than in any previous year. Much of the membership, however, is associate and non-flying, participating only for social or patriotic reasons. Data on the number of members having acquired licenses have not come to hand for 1930, but up to 1929 the total had reached 750 and was increasing about 200 each year. The clubs have been of great value in attracting the interest of a particularly desirable group who could hardly have been reached otherwise, but the volume of flying is not impressive in the aggregate. In 1929 it attained only about 2 per cent of the amount of miscellaneous flying in the United States during the year, and it has never exceeded 30 hours per pilot member per year.

Although the light plane clubs have done only comparatively little flying, they have been an important factor in encouraging private ownership. At the end of 1929 the British clubs owned only 85 planes, but their membership included 196 private owners, almost all of whom had first become interested and learned to fly upon the clubs' machines.

TABLE 1: AMERICAN LANDPLANE SPECIFICATIONS

Including only planes with Approved Type Certificates—AVIATION does not assume responsibility for the figures given

CONTINUED ON PAGE 182

Manufacturer	Designation	GENERAL: A. T. C. No.	Price at Factory	Type	No. of Seats	POWER PLANT: Make of Engine	Total Rated Hp.	R.p.m. Rated Hp.	Fuel Cap. (Gal.)	Normal Range	Fuel Consumption at Cruising Speed, Gal. per Hr.	Make of Prop.	WEIGHTS: Wing Loading (Lb. per Sq. Ft.)	Power Loading (Lb. per Hp.)	Weight Empty with Cooling Water if Used	Pay Load (Lb.)	Gross Weight (Lb.)	PERFORMANCE: High Speed (M.P.H.)	Cruising Speed (M.P.H.)	R.P.M. at Cruising	Stalling Speed (M.P.H.)	Climb at Sea Level F.P.M.	Service Ceiling (Ft.)	Performance Basis
PASSENGER PLANES WITH SEATS FOR FEWER THAN FOUR PERSONS																								
Aeromarine Klemm Corp.	AKL-25-A	121	3,350	OML	2	Salmson	40	1,900	15	.....	.....	Aero	6.3	33.1	815	239	1,325	80	70	1,850	40	400	8,500	Ms
Aeromarine Klemm Corp.	AKL-26-A	204	3,550	OML	2	Lo	65	1,950	29	.....	.....	Aero	7.57	24.5	1,025	206	1,590	90	80	1,650	42	450	10,000	Ms
Aeromarine Klemm Corp.	AKL-26-B	334	3,700	OML	2	Lb	85	2,125	29	.....	.....	Aero	7.54	18.6	1,016	206	1,581	95	85	1,800	42	500	12,000	Ms
Aeronautical Corp. of Amer.	Aeronca C-2	351	1,555	OML	1	Aeronca	26.8	2,500	8	315	2	Hz	4.73	25.1	398	50	672	80	60	2,100	38	650	14,000	Ms
Alexander Aircraft Co.	Eaglerock A-2	58	2,000	OBL	3	OX-5	90	1,400	47	460	7.2	Su	7.40	27.1	1,459	340	2,442	100	85	1,375	35	460	9,000	Ms
Alexander Aircraft Co.	Eaglerock A-14	139	5,247	OBL	3	Wr Ww	165	2,000	59	625	9.0	HSt	7.83	17.2	1,685	340	2,582	116	104	1,700	37	720	12,820	Ms
Alexander Aircraft Co.	Eaglerock A-15	190	3,200	OBL	3	K	90	1,720	47	550	6.0	Su	7.45	24.46	1,539	340	2,456	100	85	1,600	35	480	9,400	Ms
Alexander Aircraft Co.	Eaglerock A-13	141	5,859	OBL	3	Cu Ch	170	1,800	59	655	9.0	HSt	7.89	14.49	1,711	340	2,608	119	100	1,700	37	840	14,700	Ms
Alexander Aircraft Co.	Eaglerock A-1	57	2,250	OBL	3	Wr Ww	225	1,700	59	590	11.0	HSt	7.55	12.46	1,705	340	2,491	130	110	1,650	36	1,080	17,900	Ms
American Eagle Aircraft Co.	330	119	4,795	CML	3	K	100	1,850	32	400	8.5	Su	.....	.....	1,320	425	2,100	95	85	1,750	36	700	12,000	Ms
American Eagle Aircraft Co.	251	282	5,995	OBL	3	Wr Ww	165	1,850	60	550	9.0	HSt	.....	.....	1,650	527	2,669	128	110	1,800	35	780	16,000	Ms
American Eagle Aircraft Co.	201	293	3,995	OBL	3	K	100	1,850	36	425	8.5	HSt	.....	.....	1,168	366	1,950	115	100	1,750	30	700	14,000	Ms
American Eagle Aircraft Co.	Eaglet	380	1,475	OML	2	Sz	30	1,800	18	250	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Arrow Aircraft & Motors Corp.	A-2-60-L	115	2,700	OBL	2	Lb	60	1,950	16	200	6.0	Hz	7.35	19.5	900	170	1,346	100	85	1,800	30	900	14,000	Ms
Brunner-Winkle Aircraft Corp.	Bird A	101	.....	OBL	3	OX-5	90	1,400	45	600	7.0	.....	8.1	24.0	1,300	400	2,150	110	90	.....	.....	700	15,000	Ms
Brunner-Winkle Aircraft Corp.	Bird B	239	.....	OBL	3	K	90	1,825	35	525	6.0	HSt	7.5	22.0	1,190	400	1,990	110	90	.....	.....	800	16,000	Ms
Buhl Aircraft Co.	CA-3-D	163	12,000	CQL	3	Wr Ww	300	2,000	90	700	16.0	HSt	13.3	10.66	2,017	413	3,200	150	125	1,750	45	900	15,000	Ms
Curtiss-Wright Corp																								
Curtiss-Robertson	Robin OX-5	68	.....	CML	3	OX-5	90	1,400	50	481	7.0	Hz	10.1	25.1	1,504	390	2,270	105	84	1,180	44	400	10,200	Ms
Curtiss-Robertson	Robin C-1	143	.....	CML	3	Cu Ch	185	1,800	50	300	14.0	Cu Re	11.7	14.05	1,638	454	2,600	120	102	1,530	47	640	12,700	Ms
Curtiss-Robertson	Robin J-1	220	.....	CML	3	Wr Ww	165	2,000	50	338	12.5	ASt	11.28	15.3	1,625	390	2,523	118	100	1,700	45	750	13,200	Ms
Curtiss-Robertson	Moth	197	.....	OBL	2	Gy	90	1,950	35	540	7.0	Gy	6.78	16.5	1,045	200	1,650	105	90	1,670	40	700	16,200	Ms
Travel Air	E-4000	188	6,425	OBL	3	Wr Ww	165	2,000	67	675	10.0	HSt	9.35	16.4	1,695	390	2,702	122	103	1,700	54.7	600	13,000	Ms
Davis Aircraft Corp.	D-1	256	2,995	OML	2	Lb	65	1,950	20	350	4.5	Hz	9.1	19.0	840	190	1,335	101	85	1,600	38	500	12,000	Ms
Davis Aircraft Corp.	D-1-K	272	3,595	OML	2	K	100	1,850	25	350	6.5	Hz	10.1	14.6	925	197	1,461	120	105	1,800	40	1,000	14,000	Ms
Davis Aircraft Corp.	D-1-85	317	3,395	OML	2	Lb	85	2,125	20	350	5.0	Hz	10.0	16.0	854	217	1,380	112	97	1,700	38	750	13,000	Ms
Detroit Aircraft Corp.																								
Parks Air College	P-1-Trainer	179	.....	OBL	3	OX-5	90	1,400	32	300	8.0	Hz	7.16	23.10	1,331	371	2,078	90	75	1,375	35	500	10,000	Ms
Ryan	P-2-Speedster	200	.....	OBL	3	Ax	150	1,800	52	520	9.0	HSt	8.35	16.26	1,520	393	2,440	112	90	1,600	45	650	11,000	Ms
Ryan	P-2-A Speedster	276	.....	OBL	3	Wr Ww	165	2,000	52	540	9.2	HSt	8.36	14.41	1,483	370	2,380	117	95	1,700	45	725	13,000	Ms
Driggs Aircraft Corp.	Skylark	303	2,985	OBL	2	Rover	75	1,975	17	300	5.0	Hz	7.4	18.4	878	501	1,379	98	85	1,800	45	600	14,000	Ms
Fairchild Aviation Corp.	KR-21-B	368	4,525	OBL	2	KB-5	125	1,900	30	300	9.0	HSt	9.02	13.84	1,120	186	1,730	115.4	92.5	1,700	51.8	720	11,000	Ms
Fairchild Aviation Corp.	KR-34-D	376	5,675	OBL	3	Co 7-E	165	1,900	45	375	12.0	HSt	8.34	14.20	1,555	365	2,370	122	97.7	1,700	48.2	703	15,200	Ms
Fairchild Aviation Corp.	KR-21	215	4,375	OBL	2	K-5	98	1,810	22	275	7.0	Hz	8.52	16.35	1,068	191	1,603	106	91.0	1,700	48.8	530	10,400	Ms
Fairchild Aviation Corp.	KR-34-C	162	6,200	OBL	3	Wr Ww	165	2,000	45	375	12.0	HSt	8.31	14.35	1,524	356	2,368	121	97.0	1,700	48.2	655	13,900	Ms
Fleet Aircraft Inc.	I	122	.....	OBL	2	War	110	1,850	24	350	6.0	Hz	8.1	14.37	1,035	211	1,580	106	90	1,650	46.0	730	13,200	Ms
Fleet Aircraft Inc.	II	131	.....	OBL	2	K	110	1,850	24	352	6.0	Hz	8.08	14.32	1,023	218	1,575	106	90	1,650	46.0	730	13,200	Ms
Great Lakes	2-T-1-A	228	3,150	OBL	2	Cir	90	2,100	26	370	6.3	Hz, H	8.43	17.58	1,002	237	1,580	110	95	1,650	40	.....	.....	Ms
Inland Aviation Co.	S-300	259	3,485	OML	2	Lb	60	1,950	24	450	4.6	Hz	8.97	19.9	765	195	1,292	100	90	1,850	44	850	13,000	Ms
Inland Aviation Co.	W-500	315	4,985	OML	2	War-7	110	1,975	31	500	7.0	HSt	10.2	13.5	910	195	1,490	135	100	1,850	48	1,600	18,000	Ms
Inland Aviation Co.	R-400 Sportster	343	.....	OML	2	War-5	90	1,975	24	450	4.8	HSt	10.2	16.3	902	235	1,466	120	90	.....	46	1,100	14,000	Ms
E. M. Laird Airplane Co.	LC-R-300	176	11,500	OBL	3	Wr Ww	300	2,000	76	550	.....	HSt	15.3	10.3	1,922	390	3,010	165	135	.....	55	1,500	20,000	Ms
E. M. Laird Airplane Co.	LC-RJ-200	152	9,500	OBL	3	Wr Ww	220	.....	76	600	.....	HSt	14.4	13.2	1,848	390	2,914	150	120	.....	55	1,200	18,000	Ms
E. M. Laird Airplane Co.	Whirlwind LC-B	353	10,850	OBL	3	Ww	300	.....	76	550	.....	HSt	10.3	10.1	1,930	390	3,020	150	120	.....	45	1,600	22,000	Ms
E. M. Laird Airplane Co.	Speedwing LC-RW	377	14,250	OBL	3	Pwj	300	.....	78	600	.....	HSt	15.3	10.3	1,922	390	3,010	190	150	.....	58	1,600	22,000	Ms
Lincoln Aircraft, Inc.	PT	181	2,565	OBL	2	OX-5	90	1,400	29	300	8.0	Hz, Su	6.6	21.9	1,428	190	1,968	101	82	.....	37	600	11,000	Ms
Lincoln Aircraft, Inc.	PTK	2.9	3,865	OBL	3	K	90	1,825	28.5	400	.....	Su	6.0	19.6	1,176	220	1,767	104	85	.....	35	820	13,500	Ms
Lincoln Aircraft, Inc.	PTW	264	4,315	OBL	3	War	110	1,850	28.5	400	.....	Su	6.0	16.4	1,203	220	1,794	108	87	.....	35	870	14,000	Ms
Lincoln Aircraft, Inc.	AP-B-5	372	4,395	CML	3	K-B-5	125	1,950	36	450	8.0	Fahlin	10.4	17.2	1,352	412	2,180	128	103	1,800	48	830	18,000	Ms
Lincoln Aircraft, Inc.	AP-K-5	373	5,995	CML	3	K-5	90	1,810	36	450	7.0	Fahlin	10.4	21.5	1,320	412	2,148	112	97	1,700	48	500	11,000	Ms
Lincoln Aircraft, Inc.	PTT	344	3,360	OBL	2	Br	90	1,700	28.5	400	6.0	Fahlin	6.0	18.5	1,164	240	1,662	102	85	1,600	38	650	13,000	Ms
Mercury Aircraft, Inc.	Chic	2 3	3,980	OML	2	Lb	90	2,050	28	375	7.0	Hz	7.9	16.8	935	200	1,513	112	90	1,750	40	900	18,000	Ms
Mohawk Aircraft Corp.	Ml-C-K Pinto	263	4,800	OML	2	K	90	1,825	37	450	7.2	Hz	12.0	16.4	1,135	250	1,800	115	98	1,800	.....	1,100	15,000	Ms
Mohawk Aircraft Corp.	M-1-CW Pinto	297	5,100	OML	2	War	110	1,850	37	450	7.5	Hz	12.0	16.4	1,135	250	1,800	121	108	1,925	.....	1,200	16,000	Ms
Mono Aircraft Corp.	Monoprep	218	2,835	CML	2	Lam	55	2,000	.....	.....	.....	.....	9.0	23.41	783	.....	1,288	.....	.....	.....	.....	.....	.....	.....
Mono Aircraft Corp.	Monocoupe 110	327	4,500	CML	2	War-7	110	1,850	30	450	8.0	HSt	12.3	14.7	1,000	250	1,620	138	116	1,850	46	1,200	18,000	Ms
New Standard Aircraft Corp.	D-26-A	225	9,750	OBL	3	Wr Ww	220	2,000	62	500	12.4	Hz	9.55	15.5	2,055	765	3,400	110	95	1,700	38	750	14,000	Ms
New Standard Aircraft Corp.	D-29-A	216	4,185	OBL	2	K-5	100	1,810	22	290	7.2	AmerS	7.32	17.9	1,165	300	1,799	98	75	1,600	42	500	10,800	Ms
New Standard Aircraft Corp.	D-29-B	324	5,000	OBL	2	KB-5	125	1,925	38	380	9.0	HSt	7.55	14.8	1,195	234	1,850	108	85	1,600	45	650	12,000	Ms
Nicholas-Beazley Airplane Co.	NB-4-L	385	.....	OML	3	Lam	90	2,375	24	390	5.5	.....	9.52	16.82	828	350	1,511	105	87	.....	42	800	16,000	Ms
Nicholas-Beazley Airplane Co.	NB-4-W	386	.....	OML	3	War	90	2,025	24	390	5.5	.....	9.75	17.15	860	350	1,544	105	87	.....	42	800	16,000	Ms
Pitcairn Aircraft, Inc.	P-7	196	8,000	OBL	3	Wr Ww	225	1,800	71	.....	.....	HSt	.....	.....	1,821	636	3,050	145	.....	.....	.....	.....	.....	Ms
Rearwin Airplanes, Inc.	2000-C	232	6,750	OBL	3	Cu Ch	170	1,800	55	500	10.0	HSt	.....	.....	1,495	355	2,360	.....	.....	.....	.....	.....	.....	Ms
Rearwin Airplanes, Inc.	2000-CO	314	6,500	OBL	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Nicholas-Beazley Airplane Co.	NB-4-L	385	.....	OML	3	Lam	90	2,375	24	390	5.5	.....	9.52	16.82	828	350	1,511	105	87	.....	42	800	16,000	Ms
Nicholas-Beazley Airplane Co.	NB-4-W	386	.....	OML	3	War	90	2,025	24	390	5.5	.....	9.75	17.15	860	350	1,544	105	87	.....	42	800	16,000	Ms
Pitcairn Aircraft, Inc.	P-7	196	8,000	OBL	3	Wr Ww	225	1,800	71	.....	.....	HSt	.....	.....	1,821	636	3,050	145	.....	.....	.....	.....	.....	Ms
Rearwin Airplanes, Inc.	2000-C	232	6,750	OBL	3	Cu Ch	170	1,800	55	500	10.0	HSt	.....	.....	1,495	355	2,380	.....	.....	.....	.....	.....	.....	Ms
Rearwin Airplanes, Inc.	2000-CO	314	6,500	OBL	3	Con	165	2,000	55	500	10.0	HSt	.....	.....	1,447	370	2,359	.....	.....	.....	.....	.....	.....	Ms
Simplex Aircraft Corp.	Red Arrow K-28	43	3,995	OML	2	K	90	1,825	44	.....	6.5	W	11.8	19.0	1,152	170	1,779	125	110	1,700	48	1,000	12,000	Ms
Simplex Aircraft Corp.	Red Arrow W-28	238	4,495	OML	2	War	110	1,850	44	.....	7.8	W	11.8	16.0	1,150	170	1,779	125	110	1,700	48	1,200	14,000	Ms
Sioux Aircraft Corp.	Kari Keen-90	331	3,365	CML	2	Lam	90	2,375	27	400	6.5	Fahlin	.....	.....	975	200	1,535	105	90	2,150	40	700	9,000	Ms
Spartan Aircraft Co.	C-3-165	195	5,975	OBL	3	Wr Ww	165	2,000	65	600	10.0	H	9.0	15.85	1,650	370	2,612	121	100	1,750	47	820	12,000	Ms
Spartan Aircraft Co.	C-3-225	286	7,750	OBL	3	Wr Ww	225	2,000	60	496	13.0	H	9.29	12.0	1,740	390	2,700	133	110	1,750	50	1,160	15,000	Gt
Star Aircraft Co.	Cavalier C	255	2,985	CML	2	Lb	60	1,950	22	400	.....	W	9.0	21.5	855	200	1,400	100	90	.....	38	800	16,000	Ms
Star Aircraft Co.	Cavalier E	321	3,450	OML	2	Lam	.....	.....	22	400	.....	W, Su	9.07	15.83	919	185	1,425	.....	.....	.....	.....	.....	.....	Ms
Swallow Airplane Co.	T-P	105	2,878	OBL	3	OX-5	90	1,400	28	300	8.0	W	6.2	20.25	1,280	180	1,825	90	80	1,350	43	700	16,000	Ms
Swallow Airplane Co.	F-28-AX	125	.....	OBL	3	AX	150	1,800	62	600	8.0	Su	8.3	16.6	1,574	340	2,497	110	90	1,625	42	800	14,000	Ms
Swallow Airplane Co.	TP-K	186	.....	OBL	3	K	90	1,825	28	350	7.5	Su	5.75	19.0	1,170	170	1,700	100	85	1,650	42	800	16,500	Ms
Swallow Airplane Co.	TP-W	253	.....	OBL	3	War	110	1,850	28	350	7.5	Su	5.8	15.5	1,201	170	1,739	100	85	1,650	42	800	10,500	Ms
United Aircraft & Transport																								
Stearman	C-3R	251	8,500	OBL	3	Wr Ww	225	2,000	68	605	12.0	HSt	9.56	11.47	1,741	400	2,754	133	110	1,700	47	1,000	16,000	Ms
Stearman	4-E	292	16,000	OBL	3	Pww	420	2,000	106	650	21.0	HSt	12.82	9.37	2,426	629	3,936	158	130	1,700	55	1,400	18,000	Ms
Stearman	4-C	304	12,500	OBL	3	Wr Ww	300	2,000	106	835	15.0	HSt	12.38	12.67	2,256	663	3,800	145	118	1,700	55	1,000	15,000	Ms
Stearman	4-D	305	12,500	OBL	3	Pwj	300	2,000	106	815	15.0	HSt	12.38	12.67	2,297	622	3,800	143	115	1,700	55	1,000	15,000	Ms
Stearman	6-B	365	.....	OBL	2	Wr Ww	165	2,000	37	395	8.2	HSt	8.90	14.54	1,733	256	2,400	110	88	1,700	50	710	12,300	Ms
Stearman	6-F	371	.....	OBL	2	Con	165	2,000	37	395	8.2	HSt	8.90	14.54	1,727	262	2,400	110	88	1,700	50	710	12,300	Ms
United-Boeing Airplane Co.	Boeing 100	133	20,000	OBL	1	Pww	450	1,800	97	525	20.0	H	11.8	5.97	1,882	60	2,750	165	140	1,600	55	.....	.....	Ms
Verville Aircraft Co.	Sport Trainer	323	5,250	OBL	2	Con	165	2,000	36	380	9.0	HSt	9.27	13.6	1,562	.....	.....	120	95	1,800	40	850	15,000	Ms
Viking Flying Boat Co.	Kittyhawk B-2	134	4,650	OBL	3	Y	113	1,710	35	500	6.5	Hs	8.15	18.1	1,139	357	1,899	110	95	1,600	38	1,200	15,000	Ms
Viking Flying Boat Co.	Kittyhawk B-4	166	4,250	OBL	3	K	110	1,810	35	500	6.5	Hs	8.05	18.8	1,107	362	1,875	110	95	1,650	38	1,200	15,000	Ms
Waco Aircraft Co.	HSO	333	7,500	OBL	3	Pdd	225	1,900	65	700	9.0	HSt	9.03	10.8	1,814	.....	2,600	124	105	.....	.....	1,000	18,000	Ms
Waco Aircraft Co.	QSO	337	5,575	OBL	3	Con	165	2,000	65	650	10.0	Hs	9.0	15.6	1,585	.....	2,600	116	98	.....	.....	800	16,000	Ms
Waco Aircraft Co.	INF	345	4,365	OBL	3	KB-5	125	1,900	32	400	8.0	Hs	7.7	.....	1,150	.....	.....	118	98	1,750	.....	950	18,000	Ms
Waco Aircraft Co.	PSO	339	5,175	OBL	3	Jac	140	1,800	65	625	9.0	HSt	8.5	17.4	1,508	.....	2,441	106	95	1,750	.....	600	12,000	Ms
Waco Aircraft Co.	BSO	168	6,370	OBL	3	Wr Ww	165	2,000	65	625	10.0	Hs	9.03	15.75	1,529	.....	2,600	120	100	.....	.....	700	18,000	Ms
Waco Aircraft Co.	CSO	240	7,335	OBL	3	Wr Ww	240	2,000	65	600	12.0	Hs	9.03	11.5	1,620	.....	2,600	128	105	.....	.....	1,200	19,000	Ms
Waco Aircraft Co.	CTO	257	8,525	OBL	3	Wr Ww	240	2,000	65	650	12.0	HSt	11.45	11.5	1,677	.....	2,600	138	115	1,750	48	1,500	19,000	Ms
Waco Aircraft Co.	RNF	311	4,250	OBL	3	War	110	1,850	32	400	8.0	Hs	7.8	17.2	1,110	.....	1,900	.....	.....	.....	.....	.....	.....	Ms
Waco Aircraft Co.	KNF	313	4,100	OBL	3	K	100	1,810	32	385	7.0	Hs	7.8	17.2	1,095	.....	1,900	.....	.....	.....	.....	.....	.....	Ms

CARGO PLANES WITH SEATS FOR FEWER THAN FOUR PERSONS

Curtiss Aeroplane & Motor Co.	Carrier Pigeon	237	.....	OBL	1	Cu Cq	600	2,400	.....	.....	.....	Cu Re	13.82	11.96	4,235	.....	7,600	.....	.....	.....	.....	.....	.....	.....
Detroit-Lockheed Aircraft Co.	Sirius	300	.....	OML	2	Pww	420	2,000	150	980	21.5	HSt	16.7	10.95	2,978	Var	4,600	173	140	1,700	60	1,200	20,000	Gt
Detroit-Lockheed Aircraft Co.	Sirius	378	.....	OML	2	Pww	420	2,000	140	940	21.5	HSt	18.8	12.30	2,958	1,106	5,170	175	143	1,700	61	1,100	18,000	Gt
New Standard Aircraft Corp.	D-27-A	226	9,750	OBL	1	Ww-7	220	2,000	62	500	12.4	HzS	9.55	15.5	2,055	765	3,400	110	95	1,700	38	750	14,000	Ms
Pitcairn Aircraft, Inc.	PA-8, Mailwing	364	12,500	OBL	1, 3	Ww,Pwj	300	2,000	70	.....	.....	HSt	13.9	13.3	2,270	1,030	4,000	.....	.....	.....	.....	.....	.....	.....
United-Stearman Aircraft Co.	4-EM, Speedmail	322	16,000	OBL	1	Pww	420	2,000	106	645	21.0	HSt	12.82	9.37	2,455	600	3,936	158	130	1,700	55	1,400	18,000	Ms
United-Stearman Aircraft Co.	4-DM, Speedmail	325	12,500	OBL	1	Ww	300	2,000	106	835	15.0	HSt	12.82	13.12	2,285	770	3,936	145	118	1,700	55	1,000	15,000	Ms
United-Stearman Aircraft Co.	4-DM, Speedmail	326	12,500	OBL	1	Pwj	300	2,000	106	815	15.0	HSt	12.82	13.12	2,326	729	3,936	143	115	1,700	55	1,000	15,000	Ms

A —Amphibion
Ad —Aldad
Aer —Aerol
Al —Axle
Amer —American
Ans —Ansani
Apl —Applied
Aw —Air Wheels
Ax —Axelson
B —Biplane
Bak —Bakelite
Be —Beam
Bo —Bolted
Box —Box spar
Br —Brownback
Bx —Bendix
C —Closed
Ca —Cable
Can —Cantilever
Cd —Cord
Cg —Corrugated
Ch —Challenger
Cir —Cirrus
Co —Comet
Com —Compression
Con —Continental
Cq —Conquerer
Cs —Coiled Springs
Cu —Curtiss
Cv —Conventional
Cy —Cyclone
D —Duralumin
Dep —Deperdussin
Du —Dual
Ex —Extra
F —Flying boat
Fab —Fabric
Fl —Flottorp
G —Glued
Ge —Genet
Go —Goodyear
Gr —Gruss
Gt —Gov't test
Gy —Gipsy
H —Hamilton
He —Henderson
His —Hispano
Ht —Heat treated
Hw —Hess Warrior
Hyd —Hydraulic
Hz —Hartsell
I —"I" section
In —Internal
Ir —Irwin
K —Kinner
Kh —Kelsey-Hayes
L —Landplane
La-l —Ace
Lam —Lambert
Lb —LeBlond
Li —Liberty
Lk —Lockheed
Lmd —Laminated
Lr —LeRhone
Ly —Lycoming
M —Monoplane
Me —Metal
Mo —Monocoque
Ms —Mfr's Statement
N —New
Na —Navigation
O —Open
Ol —Oleo
Old —Oildraulic
Op —Optional
OX-5 —Curtiss
P —Paragon
Pe —Pedal
Pdd —Packard Diesel
Pk —P-K screws
Ply —Plywood
Pn —Pneumatic
Pr —Push Rod
Pwh —P & W Hornet
Pwj —P & W Wasp Jr.
Pww —P & W Wasp
Q —Sesquiplane
R —Rubber
Re —Reed
Ro —Routed
Rus —Rusco
Rv —Riveted
S —Steel
Sa —Sausedde
Sc —Shock Cord
Scd —Screwed
Sd —Stamped
Sh —Sheet
Sk —Stick
Sol —Solid
Sp —Spruce
Spl —Split
St —Standard
Str —Straight
Su —Supreme
Sy —Story
Sz —Szekely
T —Tubing
Tr —Trombone
Tred —Treadle
Trs —Truss
W —Wood
Wa —Walter
War —Warner
Wat —Warren Truss
We —Westinghouse
Wh —Wheel
Wi —Wire
Wl —Welded
Wr —Wright
Wt —Wind Tunnel
Ww —New Whirlwind
Y —Yankee
Z —Seaplane
• —Without engine

TABLE 2: AMERICAN LANDPLANE SPECIFICATIONS

Including only planes with Approved Type Certificates—AVIATION does not assume responsibility for the figures given

CONTINUED ON PAGE 183

Manufacturer	Designation	GENERAL: A. T. C. No.	Price at Factory	Type	No. of Seats	POWER PLANT: Make of Engine	Total Rated Hp.	R.p.m. at Rated Hp.	Fuel Cap. (Gal.)	Normal Range	Fuel Consumption at Cruising Speed, Gal. per Hr.	Make of Prop.	WEIGHTS: Wing Loading (Lb. per Sq. Ft.)	Power Loading (Lb. per Hp.)	Weight Empty with Cooling Liquid if Used	Pay Load (Lbs.)	Gross Weight (Lbs.)	PERFORMANCE: High Speed (M.P.H.)	Cruising Speed (M.P.H.)	R.P.M. at Cruising	Stalling Speed (M.P.H.)	Climb at Sea Level F.P.M.	Service Ceiling (Ft.)	Performance Basis
SINGLE-ENGINED PLANES WITH SEATS FOR MORE THAN THREE PERSONS																								
Alexander Aircraft Co.	C-7 Bullet	318	7,200	OML	4	Ww	165	2,000	44	560	9.0	HSt	13.3	16.9	1,720	610	2,780	148	124	1,675	45.0	700	17,000	—
American Eagle Aircraft Co.	C-430	320	5,995	CML	4	Con	165	1,850	60	700	9.0	HSt	.....	.....	1,875	550	3,008	.....	.....	.....	.....	.....	.....	.....
American Eagle Aircraft Co.	D-430	301	6,395	CML	4	Ww	165	1,850	60	700	9.0	HSt	.....	.....	1,864	550	2,997	125	109	1,775	38.0	850	16,000	Ms
Bellanca Aircraft Corp.	Pacemaker	328	15,450	CML	6	Ww, Pwj	300	2,000	112	850	16.0	HSt	.....	.....	2,455	1,042	4,300	145	122	1,800	.....	1,000	18,000	Ms
Bellanca Aircraft Corp.	Freighter	245	15,050	CML	4	Ww	300	2,000	85	670	16.0	HSt	.....	.....	2,290	1,570	4,600	145	122	1,800	.....	900	17,000	Ms
Bellanca Aircraft Corp.	Skyrocket	319	17,800	CML	6	Pww	420	2,000	115	650	22.0	HSt	.....	.....	2,610	1,070	4,600	150	130	1,700	.....	1,450	20,000	Ms
Bellanca Aircraft Corp.	Airbus	360	.....	CQL	12	Cu Cq	600	2,400	200	750	34.0	.....	14.2	15.8	5,490	2,572	9,500	147	125	2,150	.....	750	14,500	Ms
Buhl Aircraft Co.	CA-6	128	13,500	CQL	6	Ww	300	2,000	100	720	16.0	HSt	14.3	15.0	2,478	1,192	4,500	140	120	1,750	45.0	900	15,000	Ms
Buhl Aircraft Co.	CA-8-A	98	19,500	CQL	8	Cy	525	1,900	181	775	28.0	HSt	13.6	18.0	3,542	1,390	6,300	145	115	1,700	45.0	1,000	18,000	Ms
Buhl Aircraft Co.	CA-8-B	99	19,500	CQL	8	Pwh	525	1,950	181	775	28.0	HST	13.6	12.0	3,542	1,390	6,300	145	115	1,700	45.0	1,000	18,000	Ms
Cessna Aircraft Co.	DC-6-A	243	11,000	CML	4	Ww	300	2,000	66	.....	13.0	Su, H	11.9	10.6	1,932	610	3,180	161	130	1,700	54.0	1,400	19,000	Ms
Cessna Aircraft Co.	DC-6-B	244	9,750	CML	4	Ww	225	2,000	66	.....	11.0	Su, H	11.6	13.8	1,871	610	3,100	148	120	1,700	52.0	900	17,000	Ms
Consolidated Aircraft Co.	Fleetster 17	291	.....	CML	8	Pwh	575	1,950	150	500	30.0	HSt	17.9	9.8	3,326	1,414	5,600	175	150	1,700	65.0	1,200	18,000	Ms
Consolidated Aircraft Co.	Fleetster 17-20	369	.....	CML	8	Wr Cy	575	1,950	146	700	32.0	HSt	17.8	9.8	3,443	1,325	5,600	180	153	1,950	64.0	1,050	19,000	Gt
Consolidated Aircraft Co.	Fleetster 20	320	.....	CML	6	Pwh	575	1,950	150	500	30.0	HSt	18.8	10.3	3,439	1,600	5,900	165	140	1,700	65.0	1,100	17,500	Ms
Cunningham-Hall Aircraft Corp.	PT-6	177	13,900	CBL	6	Ww	300	2,000	90	700	15.0	HSt	11.7	13.5	2,670	920	4,350	133	110	1,675	50.0	1,050	17,500	Ms
Curtiss-Robertson Airpl. Mfg. Co.	4-C-1-A	309	7,995	CML	4	Cu Ch	185	1,800	50	481	10.1	CuRe	12.8	15.6	1,811	531	2,850	115	98	1,530	58.0	505	11,200	Ms
Curtiss-Travel Air Mfg. Co.	A-6000-A	116	16,500	CML	6	Pww	420	2,000	130	700	20.0	HSt	15.4	12.5	3,325	900	5,250	140	118	1,700	65.0	1,000	18,000	Ms
Curtiss-Travel Air Mfg. Co.	6-B	352	.....	CML	6	Ww	300	2,000	90	560	18.0	HSt	15.9	15.0	2,739	950	4,452	144	115	1,800	66.0	900	16,000	Ms
Detroit-Lockheed Aircraft Corp.	Vega Model 5B	227	.....	CML	7	Pww	420	2,000	100	700	21.5	HSt	16.4	10.7	2,595	.....	4,500	180	150	1,700	60.0	1,275	19,000	Ms
Detroit-Lockheed Aircraft Corp.	Vega DL-1	308	.....	CML	7	Pww	420	2,000	100	700	21.5	HSt	16.4	10.7	2,595	Var.	4,500	178	150	1,700	59.0	1,345	19,750	Gt
Detroit-Lockheed Aircraft Corp.	Air Express	102	.....	CML	5	Pww	420	2,000	100	675	21.5	HSt	14.8	10.4	2,533	1,012	4,375	175	147	1,700	58.0	1,200	20,000	Ms
Detroit-Ryan Aircraft Corp.	B-5	142	.....	CML	6	Ww	300	2,000	100	710	15.6	HSt	14.7	13.3	2,251	923	4,000	138	110	1,700	60.0	1,000	16,000	Ms
Detroit-Ryan Aircraft Corp.	B-7	262	.....	CML	6	Pww	420	2,000	100	540	21.5	HSt	15.7	10.2	2,503	950	4,283	144	116	1,700	61.0	1,060	16,350	Gt
Detroit-Ryan Aircraft Corp.	Foursome	346	.....	CML	4	Ww	240	2,000	70	615	12.0	HSt	14.0	13.9	2,133	568	3,350	128	105	1,700	55.0	800	14,000	Ms
Fairchild Aviation Corp.	42	242	12,900	CML	4	Ww	315	2,000	105	600	17.0	HSt	15.6	14.2	2,852	708	4,300	129	103	1,700	59.0	598	13,100	Ms
Fairchild Aviation Corp.	71-A	289	18,400	CML	7	Pww	420	2,000	148	625	25.0	HSt	17.8	13.1	2,940	1,182	5,500	133	106	1,700	64.0	790	14,150	Ms
Fokker Aircraft Corp.	X Universal	164	11,000	CML	7	Ww	300	2,000	79	535	15.5	HSt	12.6	14.3	2,482	1,099	4,300	130	105	1,700	52.0	800	14,000	Ms
Fokker Aircraft Corp.	AF-14	234	22,500	CML	9	Pwh, Cy	525	1,900	170	730	27.0	HSt	13.1	13.7	4,245	1,652	7,200	137	120	1,650	42.0	710	14,300	Gt
Fokker Aircraft Corp.	Super Universal	52	17,500	CML	8	Pww	420	2,000	120	675	21.0	HSt	14.3	13.2	3,250	1,320	5,550	138	118	1,650	56.0	850	18,000	Ms
Mono Aircraft Corp.	Monocoach	275	8,250	CML	4	Ww	225	2,000	.....	.....	.....	.....	13.9	13.7	1,919	750	3,042	133	112	.....	.....	1,200	18,000	Ms
New Standard Aircraft Corp.	D-25-A	224	9,750	OBL	5	Ww	220	2,000	62	500	12.4	HSt	9.6	15.0	2,055	710	3,345	110	95	1,700	38.0	750	14,000	Ms
Spartan Aircraft Co.	C4-225	383	11,500	CML	4	Ww	300	2,000	85	530	16.0	HSt	13.3	13.2	2,567	660	3,965	143	121	1,800	56.0	1,000	15,400	Ms
Stinson Aircraft Corp.	SM-6B	217	15,995	CML	8	Pww	425	1,950	110	575	23.0	HSt	17.1	11.7	3,496	.....	5,350	145	120	1,750	59.0	.....	18,000	Ms
Stinson Aircraft Corp.	SM-7A	298	10,495	CML	4	Ww	300	2,000	90	450	20.0	HSt	14.9	11.7	2,234	.....	3,500	144	116	1,750	58.0	.....	.....	Ms
Stinson Aircraft Corp.	SM-7B	329	10,695	CML	4	Pwj	300	1,950	90	450	20.0	HSt	14.9	11.7	2,312	.....	3,500	.....	.....	.....	.....	.....	.....	.....
Stinson Aircraft Corp.	SM-8A Jr.	295	5,775	CML	4	Ly	215	2,000	60	600	11.0	HSt	13.7	14.2	2,061	560	3,195	128	104	1,700	55.0	.....	.....	.....
Stinson Aircraft Corp.	SM-8B	294	8,495	CML	4	Ww	225	2,000	65	575	12.5	HSt	13.7	14.2	2,063	539	3,200	132	110	1,750	55.0	.....	.....	Ms
Stinson Aircraft Corp.	SM-8D	312	8,995	CML	4	Diesel	225	1,900	50	500	11.0	HSt	13.7	14.2	2,175	.....	3,200	.....	.....	.....	.....	.....	.....	Ms
United-Boeing Airplane Co.	40-B-4	183	22,500	CBL	4	Pwh	525	1,900	140	450	25.0	HSt	11.2	11.6	3,809	1,171	6,080	138	110	1,600	58.0	800	16,500	Ms
United-Boeing Airplane Co.	221	366	.....	CML	7	Pwh	575	1,950	135	500	34.0	HSt	15.0	13.9	4,990	1,930	8,000	158	137	1,700	.....	850	14,000	Ms
United-Hamilton Metalplane Co.	H-45	85	24,500	CML	8	Pww	425	1,900	140	675	23.0	HSt	14.8	13.5	3,639	.....	5,750	135	115	1,650	50.0	850	13,000	Ms
United-Hamilton Metalplane Co.	H-47	94	26,000	CML	8	Pwh	525	1,900	140	600	24.0	HSt	14.8	11.0	3,699	.....	5,750	145	125	1,650	55.0	900	15,000	Ms
United-Stearman Aircraft Co.	LT-1	187	25,000	CBL	5	Pwh	525	2,000	145	610	26.2	HSt	12.8	11.9	3,890	1,215	6,250	140	110	1,700	58.0	900	15,000	Ms
MULTI-ENGINED PLANES WITH SEATS FOR MORE THAN THREE PERSONS																								
Curtiss Aeroplane & Motor Co.	Condor	193	.....	CBL	21	2 Cu Cq	1,200	2,400	278	.....	.....	Cu Re	11.5	14.50	11,352	3,600	17,378	.....	116	.....	.....	870	17,000	Ms
Curtiss Aeroplane & Motor Co.	Kingbird D-1	347	23,333	CML	8	2 Ww	480	2,000	130	454	25.4	HSt	15.1	12.73	3,754	1,230	6,115	130	112.5	1,700	62.0	820	14,700	Ms
Curtiss Aeroplane & Motor Co.	Kingbird D-2	348	25,555	CML	8	2 Ww	600	2,000	130	415	36.0	HSt	15.1	10.20	3,877	1,230	6,115	142	120	1,700	63.0	1,000	18,000	Ms
Curtiss-Keystone Aircraft Corp.	Patrician	260	.....	CML	20	3 Cy, 3 Pwh	1,575	1,900	335	720	90.0	HSt	17.9	10.50	10,200	3,662	16,600	144	120	.....	59.0	1,080	14,500	Ms
Fokker Aircraft Corp.	AF-10A	96	54,500	CML	14	3 Pww	1,260	2,000	360	755	60.0	HSt	15.3	10.41	7,780	2,500	13,100	153	126	1,700	60.0	1,100	18,000	Gt
Fokker Aircraft Corp.	AF-32	281	110,000	CML	32	4 Pwh	2,300	1,950	700	770	112.0	HSt	18.3	10.60	14,910	5,595	24,250	146	123	1,650	63.0	850	13,000	Ms
Ford Motor Co.	4-AT-E	132	40,000	CML	14	3 Ww	900	2,000	231	570	45.0	HSt	12.9	11.25	6,500	1,725	10,130	132	107	1,700	57.0	920	16,500	Ms
Ford Motor Co.	5-AT-C	165	50,000	CML	17	3 Pww	1,260	2,000	277	560	60.0	HSt	16.2	10.70	7,600	3,643	13,500	152	122	1,700	64.0	1,050	18,500	Ms

Fokker Aircraft Corp.	AF-10A	96	54,500	CML	14	3 Pww	1,260	2,000	360	755	60.0	HSt	15.3	10.41	7,780	2,500	13,100	153	126	1,700	60.0	1,100	18,000	Gt
Fokker Aircraft Corp.	AF-32	281	110,000	CML	32	4 Pwh	2,300	1,950	700	770	112.0	HSt	18.3	10.60	14,910	5,595	24,250	146	123	1,650	63.0	850	13,000	Ms
Ford Motor Co.	4-AT-E	132	40,000	CML	14	3 Ww	900	2,000	231	570	45.0	HSt	12.9	11.25	6,500	1,725	10,130	132	107	1,700	57.0	920	16,500	Ms
Ford Motor Co.	5-AT-C	165	50,000	CML	17	3 Pww	1,260	2,000	277	560	60.0	HSt	16.2	10.70	7,600	3,643	13,500	152	122	1,700	64.0	1,050	18,500	Ms
Ford Motor Co.	7-AT	246	47,000	CML	15	2 Ww, 1 Pww	1,020	2,000	281	615	50.0	HSt	15.5	12.60	7,280	3,380	12,910	134	110	1,700	60.0	880	14,100	Ms
Ogden Aeronautical Corp.	Osprey	332	18,900	CML	6	3 Cir	270	2,000	90	500	18.0	HSt	14.4	16.70	2,850	900	4,500	130	105	1,850	65.0	650	15,000	Ms
Stinson Aircraft Corp.	SM-6000	335	23,900	CML	12	3 Ly	645	2,000	120	.....	34.5	HSt	17.3	13.5	5,475	2,022	8,500	.....	.....	.....	.....	.....	.....	.....

TABLE 3: AMERICAN SEAPLANE SPECIFICATIONS

Including only planes with Approved Type Certificates—AVIATION does not assume responsibility for the figures given

CONTINUED ON PAGE 184

Manufacturer	Designation	A. T. C. No.	Price at Factory	Type	No. of Seats	Make of Engine	Total Rated Hp.	R.p.m. at Rated Hp.	Fuel Cap. (Gal.)	Normal Range	Fuel Consumption at Cruising Speed,	Make of Prop.	Wing Loading (Lb. per Sq. Ft.)	Power Loading (Lb. per Hp.)	Weight Empty with Cooling Liquid if Used	Pay Load (Lbs.)	Gross Weight (Lbs.)	High Speed (M.P.H.)	Cruising Speed (M.P.H.)	R.P.M. at Cruising	Stalling Speed (M.P.H.)	Climb at Sea Level F.P.M.	Service Ceiling (Ft.)	Performance Basis
		GENERAL				POWER PLANT							WEIGHTS					PERFORMANCE						
American Aeronautical Corp.	S-56	287	7,375	OBA	3	K	100	1,860	28	250	7.0	P	7.5	21.5	1,447	365	2,150	86	75	1,670	40.0	400	5,500	Ms
American Aeronautical Corp.	S-56B	336	7,875	OBA	3	K	125	1,900	30	325	7.0	P	7.7	17.6	1,462	388	2,200	93	80	1,700	40.0	750	10,500	Ms
Amphibions, Inc.	Ireland N-2B	153	.....	CBA	4	Ww	300	2,000	80	450	15.0	HSt	11.4	10.4	2,900	600	4,300	115	85	1,750	46 0	650	14,000	Ms
Amphibions, Inc.	Ireland N-2C	248	.....	CBA	5	Pww	420	2,000	80	450	18	HSt	13.0	11.5	3,240	900	4,900	120	100	1,750	47.0	1,000	16,000	Ms
Amphibions, Inc.	Privateer	370	5,800	OMA	2	War	110	1,850	30	280	8.0	P	10.5	19.0	.....	210	2,100	95	75	.....	.....	.....	.....	.....
Bellanca Aircraft Corp.	Pacemaker	129	18,000	CMZ	6	Ww	300	2,000	112	700	16.0	HSt	.....	.....	2,863	1,042	4,800	136	110	1,800	.....	650	16,000	Ms
Bellanca Aircraft Corp.	Skyrocket	319	.....	CMZ	6	Pww	420	2,000	120	550	22.0	HSt	18.3	.....	3,003	1,047	5,000	142	120	1,700	.....	800	20,000	Gt
Consolidated Aircraft Co.	Commodore	258	.....	CMF	25	2 Pwh	1,150	1,950	650	1,000	60.0	HSt	15.8	15.3	10,410	5,300	17,600	128	104	1,700	.....	600	10,000	Ms
Curtiss-Keystone Aircraft Co.	Air Yacht	90	.....	CBA	8	Cy, Pwh	525	1,900	140	525	28.0	HSt	12.1	11.9	3,895	1,150	6,300	130	105	.....	55.0	850	13,800	Ms
Curtiss-Keystone Aircraft Co.	Commuter	219	16,800	CBA	4	Ww	300	2,000	70	400	15.0	HSt	9.5	13.8	2,850	640	4,150	112	87	.....	50.0	850	12,000	Ms
Detroit-Eastman Aircraft Corp.	E-2, Sea Rover	288	.....	OQF	4	Cu Ch	185	2,000	48	350	11.5	HSt	11.2	14.8	1,745	.....	2,725	110	80	1,620	50.0	550	10,000	Ms
Detroit-Eastman Aircraft Corp.	E-2-A	338	.....	OQA	3	Cu Ch	185	2,000	48	350	11.5	HSt	11.2	14.8	1,970	.....	2,725	102	80	1,620	50.0	550	9,000	Ms
Fokker Aircraft Corp.	AF-11A	222	33,775	CMA	7	Pwh, Cy	575	1,900	120	430	28.0	HSt	13.7	12.5	5,065	1,115	7,200	115	100	1,650	55.0	700	11,000	Ms
Ford Motor Co.	5-AT-C-S	296	62,000	CMZ	15	3 Pww	1,260	2,000	277	499	60.0	HSt	16.2	10.7	8,900	2,143	13,500	135	108	1,700	64.0	900	14,200	Ms
United-Boeing Airplane Co.	204	157	15,000	CBF	5	2 Pww	450	1,900	80	350	20.0	HSt	10.6	12.2	3,358	913	5,000	133	110	1,625	50.0	.....	.....	Ms
United-Sikorsky Aviation Corp.	S-38	126	.....	CQA	10	2 Pww	840	2,000	330	.....	44.0	HSt	14.3	12.3	6,550	.....	10,430	128	110	1,650	55.0	750	18,000	Ms
United-Sikorsky Aviation Corp.	S-38	356	.....	CQA	10	Pwh	1,150	1,950	330	.....	.....	HSt	14.3	.....	.....	.....	10,430	.....	.....	.....	.....	.....	.....	.....
United-Sikorsky Aviation Corp.	S-39	375	.....	CMA	5	Pwj	300	2,000	65	350	17.0	HSt	11.4	13.3	2,678	.....	4,000	120	100	1,750	54.0	750	16,000	Ms
Viking Flying Boat Co.	V-2	361	12,000	OBF	4	Ww	240	2,000	60	400	12.0	W	8.6	14.4	2,300	582	3,450	105	90	1,750	46.0	750	14,000	Ms

A —Amphibion	Br —Brownback	Cu —Curtiss	Gt —Gov't test	L —Landplane	Na —Navigation	Pwj —P & W Wasp Jr.	Sk —Stick	Wa —Walter
Ad —Alclad	Bx —Bendix	Cv —Conventional	Gy —Gipsy	La-l —Ace	O —Open	Pww —P & W Wasp	Sol —Solid	War —Warner
Aer —Aerol	C —Closed	Cy —Cyclone	H —Hamilton	Lam —Lambert	Ol —Oleo	Q —Sesquiplane	sp —Spruce	Wat —Warren Truss
Al —Axle	Ca —Gable	D —Duralumin	He —Henderson	Lb —LeBlond	Old —Oildraulic	R —Rubber	Spl —Split	We —Westinghouse
Amer—American	Can —Cantilever	Dep —Deperdussin	His —Hispano	Li —Liberty	Op —Optional	Re —Reed	St —Standard	Wh —Wheel
Ans —Ansani	Cd —Cord	Du —Dual	Ht —Heat treated	Lk —Lockheed	OX-5—Curtiss	Ro —Routed	Str —Straight	Wi —Wire
Apl —Applied	Cg —Corrugated	Ex —Extra	Hw —Hess Warrior	Lmd —Laminated	P —Paragon	Rus —Rusco	Su —Supreme	Wl —Welded
Aw —Air Wheels	Ch —Challenger	F —Flying boat	Hyd —Hydraulic	Lr —LeRhone	Pe —Pedal	Rv —Riveted	Sy —Story	Wr —Wright
Ax —Axelson	Cir —Cirrus	Fab —Fabric	Hs —Hartzell	Ly —Lycoming	Pdd —Packard Diesel	S —Steel	Ss —Szekely	Wt —Wind Tunnel
B —Biplane	Co —Comet	Fl —Flottorp	I —"I" section	M —Monoplane	Pk —P-K screws	Sa —Sausedde	T —Tubing	Ww —New Whirlwind
Bak —Bakelite	Com Compression	G —Glued	In —Internal	Me —Metal	Ply —Plywood	Sc —Shock Cord	Tr —Trombone	Y —Yankee
Be —Beam	Con —Continental	Ge —Genet	Ir —Irwin	Mo —Monocoque	Pn —Pneumatic	Scd —Screwed	Tred —Treadle	Z —Seaplane
Bo —Bolted	Cq —Conquerer	Go —Goodyear	K —Kinner	Ms —Mfr's Statement	Pr —Push Rod	Sd —Stamped	Trs —Truss	* —Without engine
Box —Box spar	Ss —Coiled Springs	Gr —Gruss	Kh —Kelsey-Hayes	N —New	Pwh —P & W Hornet	Sh —Sheet	W —Wood	

TABLE 1: AMERICAN LANDPLANE SPECIFICATIONS

Including only planes with Approved Type Certificates—AVIATION does not assume responsibility for the figures given

CONTINUED FROM PAGE 178

Manufacturer and Designation	A.T.C. Nos.	GENERAL			AREAS (Sq.Ft.)						WINGS					LANDING GEAR						FUSELAGE OR HULL			
											Spars		Ribs									Framework			
		Span	Length Overall	Height Overall	Wing	Aileron	Fin	Rudder	Stabilizer	Elevators	Material	How Fabricated	Material	How Fabricated	Covering Material	Type	Tread, In.	Wheel Type and Size	Brakes	Shock Unit Lg. and Tail	Tail Wheel	Material	How Fabricated	Covering Material	Vol. Baggage Compartment, Cu. Ft.
PASSENGER PLANES WITH SEATS FOR FEWER THAN FOUR PERSONS																									
Aeromarine Klemm, AKL-25-A	121, 204, 334	40′ 2″	24′ 6″		191	18.3	3.8	7.0	19.5	13.6	W	Box	W	Ply	W	Spl	85	Aw 20x 9	No	Old	No	W		Fab	
Aeronautical Corp. Aeronca C-2	351	36′ 0″	20′ 0″	7′ 0″	126.4	7.9	6.7	10.8	7.5	6.2	Sp	Sol	Sp	G	Fab	Spl	60	Go 16x 7	No	Sp	No	ST	Wl	Fab	3.0
Alexander Eaglerock	58, 139, 190, 141, 57	36′ 8″	25′11″	9′10″	330	42.6	4.2	10.2	23.8	16.8	W	Lmd, I	W	Trs	Fab	Spl	72	Kh–Var	Ex	Cd		ST	Wl	Fab	5.9
American Eagle 330	119	37′ 0″	24′ 0″	8′ 0″	212						W	Ro			Fab	Spl	64	26x 4		Ol		ST	Wl	Fab	
American Eagle 251	282	31′ 0″	23′ 3″	8′ 4″	300						W	Ro	W		Fab	Spl	72	30x 5		Old	No	ST	Wl	Fab	
American Eagle 201	293	31′ 1″	22′11″	8′ 5″	253						W	Ro	W		Fab	Spl	65	Aw		Ol	No	ST	Wl	Fab	
American Eagle "Eaglet"	380	34′ 4″	21′ 6″	6′10″																					
Arrow Aircraft	115	25′10″	19′ 3″	7′ 5″	183	8.75	2.9	5.8	13.0	10.4	W	G	W	G	Fab	Spl	78	Wi 26 x4		Cs	No	ST	Wl	Fab	3.0
Brunner-Winkle "Bird"	101, 239	34′ 0″	23′ 0″	8′ 0″	266						W		W		Fab	Spl			No			ST	Wl	Fab	
Buhl CA-3-D	163	36′ 0″	28′ 0″	8′ 0″	240	61.0	4.7	8.1	13.6	18.0	Sp	Box	Sp		Fab	Spl		Bx 30x 5	Yes	Ol	Yes	ST	Wl	Fab	14.0
Curtiss Robertson Robin	68, 143, 220	41′ 0″	25′10″	8′ 0″	224	22.3	5.4	9.7	25.2	16.8	W	G	Ad	Sd	Fab	Spl	96	Bx 28x 4	Bx	Ol	No	ST	Wl	Fab	12.5
Curtiss Robertson Moth	197	30′ 0″	24′11″	8′ 9″	215	22.2	2.7	9.5	13.3	12.9	Sp	G	Ad	Sd	Fab	Spl	60	24x 4		ıt	No	ST	Wl	Fab	2.0
Curtiss-Wright Travelair	188	33′ 0″	24′ 1″	8′11″	289	19.5	4.5	9.2	16.8	16.8	Sp	Ro	Sp	Trs	Fab	Spl	78	Bx 30x 5	Bx	Sc	No	ST	Wl	Fab	9.0
Davis D-1	256, 272, 317	30′ 3″	21′ 6″	7′ 0″	145						Sp	Ro-Lmd	D	Sd	Fab	Spl	78	Kh		Sc		ST	Wl	Fab	
Detroit Aircraft-Parks P-1	179	30′ 1″	24′ 1″	9′ 4″	263	27.0	4.0	7.2	27.4	16.9	Sp	Ro	Sp,P y	G	Fab	Spl	99	Wi 28x 4		Rus	No	ST	Wl	Fab	2.0
Detroit Aircraft-Ryan P-2	200, 276	29′10″	23′ 6″	9′ 3″	251	34.0	4.0	7.2	27.4	16.9	Sp	Ro	Sp,Ply	G	Fab	Spl	65	Bx 30x 5	Bx	Rus	No	ST	Wl	Fab	2.5
Driggs Skylark	303	28′ 3″	21′ 6″	8′ 0″	166	19.4	3.8	7.3	13.8	10.9	Sp	Sol	D	Sd	Fab	Spl	72	Wi		Old, R	No	ST	Wl	Fab	
Fairchild KR-21	215, 368	27′ 0″	22′ 1″	8′ 6″	192.6	16.9	4.4	5.5	12.9	8.6	Sp	Sol	Sp	G	Fab	Spl	61	Acp	Yes	Ol	No	ST	Wl	Fab	2.75
Fairchild KR-34	162, 376	30′ 0″	23′ 2″	8′ 9″	285	36.4	4.5	7.5	37.4	16.9	Sp	Sol	Sp	G	Fab	Spl	66	Bx 28x 4	Bx	Ol	No	ST	Wl	Fab	8.25
Fleet	122, 131	28′ 0″	21′ 0″	7′10″	182	11.8	1.6	8.1	13.1	4.8	Sp	Lmd	D	Rv	Fab	Spl	64	Wi 26x 5	Dp	·l	No	ST	Wl	Fab	
Great Lakes 2-T	228	26′ 8″	20′ 4″	7′11″	171	16.6	3.5	5.7	13.5	9.5	Sp	I	D	Sd	Fab	Spl	70	Wi 24x 4	Bx	Ol	No	ST	Wl	Fab	
Inland Sport	259, 315, 343	30′ 0″	19′11″	7′ 2″	131.5	12.5	5.8	6.1	13.0	8.9	Sp	Ro	Sp	Trs	Fab	Spl	86	Acp	Op	Old		ST	Wl	Fab	6.0
Laird LC-R	176	34′ 0″	23′ 9″	9′ 3″	202		13.0		26.0		W	Sol	Sp	G	Fab	Spl		Bx	Bx	R, Cd	No	DT	Rv	Fab	
Laird LC-RJ	152	28′ 0″	22′ 9″	9′ 3″	202		13.0		26.0		W	Sol	Sp	G	Fab	Spl		Bx	Bx	ıt, Cd	No	DT	Rv	Fab	
Laird Whirlwind	353	34′ 0″	23′ 9″	9′ 3″	295			13.0		36.0	Sp	Sol	Sp,Ply	G	Fab	Spl		Bx 30x 5	Yes	Sc	No	D		Fab	40.0
Laird Speedwing	377	28′ 0″	22′ 7″	9′ 0″	202			13.0		26.0	Sp	Sol	Sp,Ply	G	Fab	Spl		Bx 30x 5	Yes	Sc	No	D		Fab	38.0
Lincoln PT	181, 279, 284, 344	32′ 3″	25′ 3″	9′ 3″	246	30.5	5.2	7.5	17.5	16.0	Sp	Sol	W		Fab	Spl	76	26x 4		Sc		ST	Wl	Fab	2.0
Lincoln AP	372, 373	37′ 0″	26′ 0″	8′ 4″	188	18.6	6.8	7.9	22.0	15.0	Sp	ao, I	W		Fab	Spl	104	7.5x10	Apc	Apc		ST	Wl	Fab	9.0
Mercury Chic	235	35′ 8″	23′ 0″	8′ 7″	192	34.0	6.9	5.8		18.6	ST	Wl	ST	Wl	Fab	Spl	77.5	28x 4	No	Sc R	No	ST	Wl	Fab	
Mono Corp. Monoprep	218	32′ 0″	21′ 0″								W		W		Fab	Spl				Ol Cs		ST	Wl	Fab	
Mono Corp. Monocoup	327	32′ 0″	20′ 4″	6′11″	132.3	15.5	4.1	5.8	10.6	9.2	Sp	Sol	Sp	G	Fab	Spl	63	6.5x10	AP	Old	Yes	ST	Wl	Fab	4.5
Mohawk Pinto	263, 297	34′11″	24′ 2″	7′ 7″	145	11.9	5.3	6.7	15.5	11.1	W	Box	Ply	G	Fab	Spl	101	Bx 24x 4	Bx	Aer	No	ST	Wl	Fab	9.3
New Standard D-26	225	45′ 0″	26′10″	10′ 2″	350	26.0	6.5	12.8	33.2	19.7	Sp	I	Ply	G	Fab	Spl	96			Old	Yes	D	Rv	Fab	3.4
New Standard D-29	216, 324	30′ 0″	24′ 5″	9′ 2″	245	10.7	3.6	9.9	19.5	13.5	Sp	Sol	Ply	G	Fab	Spl	78	Kh 26x 4		Old		D	Rv	Fab	2.5
Nicholas-Beazley NB-4	385, 386	32′ 9″	23′ 6″	6′11″	159	19.5	4.6	6.3	15.9	10.9	D	Sd	D	Sd	Fab	Spl	72	Wi 24x 3	No	Ol	No	ST	Wl	Fab	
Pitcairn P-7	196	33′ 0″	23′ 9″	9′ 6″	222	20.8	4.2	6.2	15.4	12.5	Sp	Ro	Sp		Fab	Spl	78	Bx 30x 5	Bx	Cr		ST	Wl	Fab	42.0
Rearwin 2000	232, 314	35′ 0″	25′ 0″	9′11″														Bx 28x 4	Bx	n, Ol					
Simplex Red Arrow	43, 238	34′ 2″	22′ 0″	6′11″	150	18.0	3.6	5.5	9.4	15.1	W	Box	Sp	G	Fab	Spl		26x 4	Op	Old, Sc	No	ST	Wl	Fab	
Sioux Kari Keen	331	30′ 0′	23′ 2″	7′ 0″	163						Sp	Box	Sp	G	Fab	Spl	72	Aw	Yes		No	ST	Wl	Fab	9.0
Spartan C-3	195, 286	32′ 0″	23′ 3″	8′10″	266	25.0	8.1	7.8	23.6	18.0	Sp	I, Sol	Sp,Ply	G	Fab	Spl	83	Bx 30x 5	Bx	Cs, Hyd	Op	ST	Wl	Fab	6.8
Star Cavalier	255, 321	31′ 6″	20′ 1″	6′ 8″	139	17.9	4.8	7.3	14.9	9.9	Sp	Ro, I	Sp	G	Fab	Spl	61	Aw 22x 10		Cs		ST	Wl	Fab	
Swallow TP	105, 186, 253	30′11″	23′ 9″	8′10″	268	28.0	3.6	7.8	14.0	16.5	W	G	W	G	Fab	Str, Al	72	26x 4		Sc		ST	Wl	Fab	
Swallow F	125				272	28.0	3.6	8.5	17.5	18.5	W	G	W	G	Fab	Spl	72	30x 5	Bx	Sc		ST	Wl	Fab	
United Boeing 100	133	30′ 0″	20′ 8″	9′ 7″	228	13.8	1.8	8.2	19.9	13.4	Sp	Box	Sp	G	Fab	Str	75	Bx 30x 5	Bx	Ol	No	S, D	Wl,Rv	D,Fab	4.0
United Aircraft-Stearman C	251	35′ 0″	24′11″	9′ 8″	266	22.0	4.6	9.6	25.0	14.6	Sp	Sol, I	Sp	Trs	Fab	Spl	90	Kh 30x 5		Ol, R	No	ST	Wl	Fab	10.0
United Aircraft-Stearman 4	292, 304, 305	38′ 0″	26′11″	10′ 2″	284	23.1	6.8	12.5	27.7	15.0	Sp	Sol	Sp	Trs	Fab	Spl	96	Bx 30x 5	Bx	Aer	Yes	ST	Wl	Fab	5.0
United Aircraft-Stearman 6	365, 371	32′ 0″	24′ 3″	9′ 6″	242.9	26.6	4.4	7.6	19.1	14.5	Sp	Sol	Sp	Trs	Fab	Spl	85	Bx 30x 5	Bx	Aer	Yes	ST	Wl	Fab	3.5
Verville Sport Trainer	323	31′ 0″	24′ 3″	8′ 9″	242	27.6	3.1	9.3	16.6	13.3	Sp	Sol	W	G	Fab	Spl	96		Bx	Old	Yes	ST	Wl	Fab	5.0
Viking Kittyhawk	134, 166	28′ 0″	22′ 6″	8′ 8″	233	22.3	5.7	6.4	24.0	12.8	Sp	Ro	W	G	Fab	Spl	86	Kh 26x 4	Op	R, Com	No	ST	Wl	Fab	3.0
Waco F	311, 313, 345	29′ 6″	21′ 4″	8′ 9″	241	22.0	4.5	7.0	12.0	15.5	Sp	Sol	Sp,Ply	G	Fab	Spl	76	6.5x10	AP	Ol	Yes	ST	Wl	Fab	
Waco Taperwing	257	30′ 3″	22′ 7″	9′ 0″	227		4.9	7.8	16.1	14.7	W	Sol	W	Trs	Fab	Spl	78	30x 5	Bx	Hyd		ST	Wl	Fab	
Waco Straightwing	168, 240, 333, 337, 339	30′ 7″	23′ 1″	9′ 0″	288	28.7	4.9	7.8	19.5	16.5	Sp	Sol	Sp,Ply	G	Fab	Spl	78	30x 5	Bx	Ol	No	ST	Wl	Fab	
CARGO PLANES WITH SEATS FOR FEWER THAN FOUR PERSONS																									
Curtiss-Wright Carrier Pigeon	237	47′ 6″	34′ 6″								ST	Wl	D			Spl			Yes	Ol				MoMe	
Detroit-Lockheed Sirius	300, 378	42′10″	27′ 6″	9′ 2″	250	25.0	11.0	13.0	39.0	23.5	Sp	Box	Sp	G	Ply	Spl	144	Bx 32 x6	Bx	Ol	No	W	Mo	Ply	50.0
New Standard D-27	226	45′ 0″	26′10″	10′ 2″	350	26.0	6.5	12.8	33.2	19.7	Sp	I	Ply	G	Fab	Spl	96	Sa	Sa	AP	Yes	D	Rv	Fab	64.0
Pitcairn Mailwing	364	35′ 0″	24′ 9″	9′ 9″	278	26.5	6.3	7.9	16.5	16.3	Sp		Sp		Fab	Spl		Bx 32x 6	Bx			ST	Wl	Fab	
United-Stearman Speedmail	322, 325, 326	38′ 0″	26′11″	10′ 2″	284	23.1	6.8	11.2	27.2	16.8	Sp	Sol	Sp	Trs	Fab	Spl	96	Bx 30x 5	Bx	Aer	Yes	ST	Wl	Fab	45.0

TABLE 2: AMERICAN LANDPLANE SPECIFICATIONS

Including only planes with Approved Type Certificates—AVIATION does not assume responsibility for the figures given

CONTINUED FROM PAGE 180

SINGLE-ENGINED PLANES WITH SEATS FOR MORE THAN THREE PERSONS

Manufacturer and Designation	A. T. C. Nos.	GENERAL			AREAS (Sq.Ft.)						WINGS					LANDING GEAR						FUSELAGE OR HULL			
											Spars		Ribs									Frame-work			
		Span	Length Overall	Height Overall	Wing	Aileron	Fin	Rudder	Stabilizer	Elevators	Material	How Fabricated	Material	How Fabricated	Covering Material	Type	Tread, In.	Wheel Type and Size	Brakes	Shock Unit Lg. and Tail	Tail Wheel	Material	How Fabricated	Covering Material	Volume Baggage Compartment, Cu.Ft.
Alexander Bullet	318	36′ 0″	26′10″	7′ 9″	208	27.5	3.1	9.7	11.1	7.0	W	Lmd	W	Trs	Fab	Cant	78	Bx 23x 5	Bx	Ol	....	ST	Wl	Fab	4.0
American Eagle C-D	301, 320	41′ 0″	27′ 4″	8′ 1″	233	29.6	6.4	10.2	19.8	18.0	W	Ro	W	Sc	Fab	.....	70	30x 5	....	Old	....	ST	Wl	Fab	.....
Bellanca, (Pac. Frt. Sky.)	129, 245, 319, 328	46′ 4″	29′ 9″	8′ 4″	273	....	.....	.....	.....	....	Sp	Sol	Sp	G	Fab	Spl	90	Bx 32x 6	Bx	Old	Yes	ST	Wl	Fab	.....
Bellanca Airbus	360	65′ 0″	40′ 8″	11′ 7″	651	.....	.....	.....	.....	....	W	Sol	W	G	Fab	.....	222	Aw	Go	Old	Yes	ST	Wl	Fab	85.0
Buhl CA-8	98, 99	48′ 0″	36′ 0″	10′ 0″	462	30.0	5.8	12.7	24.3	24.7	Sp	Box	Sp	.....	Fab	Spl	....	Bx 36x 8	Bx	Ol	Yes	ST	Wl	Fab	50.0
Buhl CA-6	128	40′ 0″	29′ 8″	8′ 7″	315	27.5	5.0	8.7	18.0	18.7	Sp	Box	Sp	.....	Fab	Spl	....	Bx 32x 6	Bx	Ol	Yes	ST	Wl	Fab	24.0
Cessna DC-6	243, 244	40′ 8″	27′11″	7′ 8″	265	17.8	5.3	9.3	22.2	16.2	Sp	Box	Ply	G	Fab	Spl	102	Bx 30x 5	Bx	Old	Yes	ST	Wl	Fab	18.0
Cunningham-Hall PT-6	177	41′ 8″	29′ 8″	9′11″	330	31.0	7.5	13.0	29.5	22.5	S	Bo	D	Rv	Fab	Spl	94	Bx 32x 6	Bx	Aer, Sc	Op	ST	Wl	Ad	27.0
Curtiss Robin 4-C-1-A	309	41′ 4″	25′ 1″	8′ 0″	203	22.3	10.7	10.5	25.2	16.8	Sp	I	Ad	Sd	Fab	Spl	101	Bx 30x 5	Bx	Ol	Yes	ST	Wl	Fab	12.5
Curtiss Travelair A-6000	116	54′ 5″	31′ 2″	9′ 2″	340	33.5	6.3	13.5	35.1	21.2	Sp	Box	Sp	Trs	Fab	Spl	108	Bx 36x 8	Bx	Ol, Cs	Yes	ST	Wl	Fab	27.8
Curtiss Travelair 6-B	352	48′ 6″	31′ 4″	9′ 3″	282	30.4	6.8	13.5	35.1	21.2	Sp	Box	Sp	Trs	Fab	Spl	108	Bx 32x 6	Bx	Ol, Cs	Yes	ST	Wl	Fab	27.8
Detroit-Lockheed Vega	140, 252, 227, 93	41′ 0″	27′ 6″	8′ 2″	250	25.0	12.5	10.2	31.5	16.0	Sp	Box	Sp	G	Ply	Spl	96	Bx 32x 6	Bx	Ol	Yes	W	Mo	Ply	12.0
Detroit-Lockheed Vega DL-1	308	41′ 0″	27′ 6″	8′ 2″	250	25.0	12.5	10.2	31.5	16.0	Sp	Box	Sp	G	Ply	Spl	96	Bx 32x 6	Bx	Ol	Yes	Ad	Rv	Ad	12.0
Detroit-Lockheed Air Express	102	43′ 0″	27′ 6″	9′ 8″	270	25.0	10.6	8.5	39.0	23.5	Sp	Box	Sp	G	Ply	Spl	96	Bx 32x 6	Bx	Ol	Yes	W	Mo	Ply	25.0
Detroit-Ryan Brougham	142, 262	42′ 4″	29′11″	9′10″	250	22.0	6.2	11.1	27.5	17.0	Sp	G	Sp	G	Fab	Spl	120	Bx 30x 5	Bx	Ol	Yes	ST	Wl	Fab	20.0
Detroit-Ryan Foursome	346	42′ 3″	27′10″	9′ 9″	219	20.0	8.9	9.5	27.5	17.0	Sp	G	S	Bsd	Fab	Spl	108	Bx 30x 5	Bx	R	Yes	ST	Wl	Fab	5.0
Consolidated Fleetster	291	45′ 0″	31′ 9″	9′ 2″	313	33.4	13.5	10.6	25.3	17.2	Sp	Box	Sp	Trs	Ply	Spl	96	Bx 32x 6	Bx	Ol	Yes	D	Rv	D	20.0
Consolidated Fleetster	320, 369	45′ 0″	31′ 9″	10′ 7″	280	33.4	13.5	10.6	25.3	17.2	Sp	Box	Sp	Trs	Ply	Spl	96	Bx 32x 6	Bx	Ol	Yes	D	Rv	D	20.0
Fairchild 42	242	45′ 0″	30′10″	9′ 2″	272	36.0	4.0	12.0	30.4	24.6	Sp	Box	Sp	G	Fab	Spl	99	Bx 30x 5	Bx	Ol, R	Yes	ST	Wl	Fab	37.0
Fairchild 71	289	50′ 0″	32′12″	9′ 4″	310	34.0	4.0	12.0	30.4	24.6	Sp	Box	Sp	G	Fab	Spl	91	Bx 32x 6	Bx	R	Yes	ST	Wl	Fab	13.0
Fokker X Universal	164	47′ 9″	33′ 6″	8′ 6″	341	20.0	2.2	11.6	23.9	25.7	Sp	Box	Ply	G	Ply	Spl	120	Sa 32x 6	Sa	Rus	No	ST	Wl	Fab	30.0
Fokker AF-14	234	59′ 5″	43′ 4″	12′ 4″	550	36.0	4.7	13.5	36.8	34.7	Sp	Box	Ply	G	Ply	Spl	162	Bx 36x 8	Bx	Gr, Rus	Yes	ST	Wl	Fab	34.0
Fokker Superuniversal	52	50′ 8″	36′11″	9′ 1″	387	22.8	2.2	11.6	23.9	25.7	Sp	Box	Ply	G	Ply	Tred	124	Sa 32x 6	Sa	Cd, Rus	No	ST	Wl	Fab	300.0
Mono Monocoach	275	39′ 0″	26′ 9″	.....	122	.....	.....	.....	.....	.....	W	.....	W	.....	Fab	Spl	.....	.....	Bx	Ol, Cs	No	ST	Wl	Fab	.....
New Standard D-25	224	45′ 0″	26′10″	10′ 2″	350	26.0	6.5	12.8	33.2	19.7	Sp	I	Ply	G	Fab	Spl	96	Sa	Sa	Old	Yes	D	Rv	Fab	4.0
Spartan C-4	310, 383	50′ 0″	32′ 7″	9′ 0″	299	18.3	9.3	14.6	13.5	12.9	Sp	I, Sol	Ply	G	Fab	Spl	120	Bx 32x 6	Bx	Cs, Hyd	Yes	ST	Wl	Fab	9.6
Stinson SM-6	247	52′ 8″	34′ 4″	10′ 0″	300	34.0	9.0	11.7	27.1	22.3	Sp	Ro	Sp	G	Fab	Spl	114	Bx 32x 6	Bx	Own	Yes	ST	Wl	Fab	.....
Stinson SM-7, 8	294, 295, 298, 312, 329	41′ 8″	31′ 0″	8′ 9″	209	25.4	5.2	11.6	23.3	23.3	Sp	Ro	Sp	G	Fab	Spl	115	Wi 30x 5	Kh	Own	Yes	ST	Wl	Fab	7.0
United-Boeing 40-B	183	44′ 2″	33′ 4″	11′ 9″	545	36.0	8.4	15.9	43.2	28.3	Sp	Ro	Sp	Web	Fab	Str	80	Bx 36x 8	Bx	Ol	No	ST	Wl	D, Fab	25.0
United-Boeing 221	366	59′ 1″	40′ 9″	.....	525	42.0	9.4	18.4	52.8	37.2	D	Bo, Rv	D	Rv	D	Spl	101	Bx 36x 8	Bx	Ol	Yes	D,S	Rv,Wl	D	100.0
United-Hamilton H-45, 47	85, 94	54′ 5″	35′ 2″	9′ 4″	390	24.2	8.6	11.9	31.5	20.9	D	Rv	.....	.....	Ad	Spl	163	Bx 32x 6	Bx	Aer, R	Yes	D	Rv	Ad	55.0
United-Stearman LT-1	187	49′ 0″	32′ 6″	12′ 6″	460	29.6	9.2	14.1	30.8	28.0	Sp	Box	Sp	Trs	Fab	Spl	96	Bx 36x 8	Bx	Aer	Yes	ST	Wl	Fab	40.0

MULTI-ENGINED PLANES WITH SEATS FOR MORE THAN THREE PERSONS

Curtiss-Wright Condor	193	91′ 8″	57′ 1″	16′ 6″	1,512	241	....	53.0	....	47.6	D	Rv	D	Rv	Fab	Tred	.....	.....	Yes	Ol	Yes	D	Rv	Ply	.....
Curtiss-Wright Kingbird	347, 348	54′ 6″	34′10″	10′ 0″	357.2	47.8	10.3	27.6	65.1	37.3	S	Wl	D	Rv	Fab	Spl	163	Bx 36x 8	Bx	Ol	Yes	DT	Rv	Fab	15.0
Curtiss-Keystone Patrician	260	86′ 6″	61′ 7″	13′ 4″	930	64.0	27.8	31.9	62.8	44.6	W	Box	W	G	Fab	Spl	234	44x10	Yes	Ol	Yes	ST	.....	Fab	75.0
Fokker AF-10A	96	79′ 3″	50′ 7″	12′ 9″	794	60.0	18.0	20.5	41.0	44.0	W	Box	Ply	G	Ply	Tred	186	Sa 44x10	Sa	Cd	No	ST	Wl	Fab	62.0
Fokker AF-32	281	99′ 0″	70′ 2″	16′ 2″	1,330	91.8	30.4	56.0	90.0	77.4	Sp	Box	Ply	G	Ply	Tred	240	Bx 58x14	Bx	Gr	Yes	ST	Wl	Fab	120.0
Ford 4-AT-E	132	74′ 0″	49′10″	11′ 9″	733	52.0	11.7	24.2	51.3	39.2	D	Rv	.....	.....	Ad	Tred	201	Wi 36x 8	Hyd	Aer	Yes	D	Rv	Ad	30.0
Ford 5, 7-AT-E	165, 246	77′10″	50′ 3″	12′ 0″	783	52.0	11.7	24.2	65.3	46.8	D	Rv	.....	.....	Ad	Tred	223	Wi 36x 8	Hyd	Aer	Yes	D	Rv	Ad	30.0
Ogden Osprey	332	50′ 0″	34′ 6″	9′ 3″	286	26.0	9.2	9.5	24.8	17.5	Sp	Box	Sp	Trs	Fab	Spl	168	Bx 32x 6	Bx	Old	Yes	ST	Wl	Fab	12.0
Stinson Tri-motor Sm-6000	335	60′ 0″	42′10″	12′ 0″	490	42.0	10.0	16.0	42.2	23.0	ST	Wl	D	Rv	Fab	Spl	204	Bx 36x 8	Bx	Aer	Yes	ST	Wl	Fab	.....

See page 184 for key

TABLE 3: AMERICAN SEAPLANE SPECIFICATIONS

Including only planes with Approved Type Certificates—AVIATION does not assume responsibility for the figures given

CONTINUED FROM PAGE 181

Manufacturer and Designation	A. T. C. Nos	GENERAL			AREAS (Sq.Ft.)						WINGS					LANDING GEAR						FUSELAGE OR HULL			
											Spars		Ribs									Frame-work			
		Span	Length Overall	Height Overall	Wing	Aileron	Fin	Rudder	Stabilizer	Elevators	Material	How Fabricated	Material	How Fabricated	Covering Material	Type	Tread, In.	Wheel Type and Size	Brakes	Shock Unit Lg. and Tail	Tail Wheel	Material	How Fabricated	Covering Material	Volume Baggage Compartment, Cu. Ft.
American Aeronautical S-56	287, 336	34′ 1″	25′ 2″	10′ 1″	262	24.2	9.6	8.0	17.5	15.5	Sp	Box	Sp	G	Fab		64	Wi 20x 4	No	Sc	No	W	Bo	Ply	
Amphibions, Inc. Ireland	153, 248	40′ 0″	31′ 0″	12′ 2″	323	53.2	15.6	18.2	19.1	25.8	Sp	Ro	D	Sd	Fab	Spl	94	Bx 32x 6	No	Ol	No	ST	Wl	Ad	
Amphibions, Inc. Privateer	370	38′ 0″	28′ 0″	9′ 6″	198	26.5	11.0	10.9	25.1	16.6	Sp	I	S	Wl	Fab	Cant	62	Kh 21x 6	No	Aw	Yes	Sp	Bo	Ad	3.0
Bellanca Pacemaker, Skyrocket	129, 319	46′ 4″	27′ 10″		273						W	Sol	W	G	Fab							ST	Wl	Fab	12.0
Consolidated Commodore	258	100′ 0″	61′ 6″	15′ 8″	1,000	110	23.7	40.2	81.0	54.5	D	Rv	D	Rv	Fab							D	Rv	D	216.0
Curtiss-Keystone Air Yacht	90	46′ 8″	34′ 9″	13′ 2″	500	60.6	27.4	18.7	37.0	27.6	Sp	Sol	D	Sd	Fab	Spl	94	36x 8	No	Aer	No	W	Bo	D	20.0
Curtiss-Keystone Commuter	219	40′ 0″	32′ 1″	13′ 6″	437	30.0	28.0	16.3	40.0	22.0	Sp	Sol	D	Sd	Fab	Spl	93	30x5	No	Ol	No	W	Bo	D	3.0
Detroit-Eastman E-2	288, 338	36′ 0″	26′ 3″	9′ 4″	207	36.0	6.1	9.5	27.4	16.0	Sp	Box	Sp	G	Fab	Spl	55	20x 6	No	Ol	No	W	Bo	Ad	
Fokker AF-11A	222	59′ 0″	45′ 10″	14′ 5″	550	36.0	28.0	18.0	39.0	36.0	Sp	Box	Ply	G	Ply	Spl	122	Bx 36x 8	Bx	Rus	No	D	Rv	D	30.0
Ford 5-AT-C8	296	77′ 10″	51′ 4″	14′ 6″	783	52.0	11.7	32.0	65.3	46.8	D	Rv			Ad		177					D	Rv	Ad	30.0
United-Boeing 204	157	39′ 8″	32′ 6″	12′ 0″	470	38.4	14.5	17.1	26.0	28.0	Sp	Ro	Sp	Web	Fab							Ply	G, Bo		15.0
United-Sikorsky S-38	126, 356	71′ 8″	40′ 3″	13′ 10″	720	42.5	15.0	20.0	51.4	35.5	D	Trs	D	Trs	Fab	Hyd		Go	Own	Hyd		W	Sd	Ad	
United-Sikorsky S-39	375	52′ 0″	31′ 11″	11′ 3″	320	30.0	4.8	20.6	29.8	18.5	D	Trs	D	Trs	Fab	Hyd	120	Go	Own	Hyd	Yes	D	Sd	Ad	26.0
Viking V-2	361	42′ 4″	29′ 4″	10′ 4″	359	42.1	4.0	13.0	32.2	27.3	Sp	Box	Ply	G	Fab							W	G	Ply	3.0

A —Amphibion
Ad —Alclad
Aer —Aerol
Al —Axle
Amer—American
Ans —Ansani
Apl —Applied
Aw —Air Wheels
Ax —Axelson
B —Biplane
Bak —Bakelite
Be —Beam
Bo —Bolted
Box —Box spar
Br —Brownback
Bx —Bendix
C —Closed
Ca —Cable
Can —Cantilever
Cd —Cord
Cg —Corrugated
Ch —Challenger
Cir —Cirrus
Co —Comet
Com —Compression
Con —Continental
Cq —Conquerer
Cs —Coiled Springs
Cu —Curtiss
Cv —Conventional
Cy —Cyclone
D —Duralumin
Dep —Deperdussin
Du —Dual
Ex —Extra
F —Flying boat
Fab —Fabric
Fl —Flottorp
G —Glued
Ge —Genet
Go —Goodyear
Gr —Gruss
Gt —Gov't test
Gy —Gipsy
H —Hamilton
He —Henderson
His —Hispano
Ht —Heat treated
Hw —Hess Warrior
Hyd —Hydraulic
Hz —Hartzell
I —"I" section
In —Internal
Ir —Irwin
K —Kinner
Kh —Kelsey-Hayes
L —Landplane
La-l —Ace
Lam —Lambert
Lb —LeBlond
Li —Liberty
Lk —Lockheed
Lmd —Laminated
Lr —LeRhone
Ly —Lycoming
M —Monoplane
Me —Metal
Mo —Monocoque
Ms —Mfr's Statement
N —New
Na —Navigation
O —Open
Ol —Oleo
Old —Oildraulic
Op —Optional
OX-5—Curtiss
P —Paragon
Pe —Pedal
Pdd —Packard Diesel
Pk —P-K screws
Ply —Plywood
Pn —Pneumatic
Pr —Push Rod
Pwh —P & W Hornet
Pwj —P & W Wasp Jr.
Pww —P & W Wasp
Q —Sesquiplane
R —Rubber
Re —Reed
Ro —Routed
Rus —Rusco
Rv —Riveted
S —Steel
Sa —Sausedde
Sc —Shock Cord
Scd —Screwed
Sd —Stamped
Sh —Sheet
Sk —Stick
Sol —Solid
Sp —Spruce
Spl —Split
St —Standard
Str —Straight
Su —Supreme
Sy —Story
Sz —Szekely
T —Tubing
Tr —Trombone
Tred —Treadle
Trs —Truss
W —Wood
Wa —Walter
War —Warner
Wat —Warren Truss
We —Westinghouse
Wh —Wheel
Wi —Wire
Wl —Welded
Wr —Wright
Wt —Wind Tunnel
Ww —New Whirlwind
Y —Yankee
Z —Seaplane
* —Without engine

TABLE 4: AMERICAN ENGINE SPECIFICATIONS

AVIATION does not assume responsibility for the figures given

Manufacturer or Agent	Engine	Cooling System	Cylinder Arrangement	No. of Cylinders	Strokes per Cycle	Propeller Drive	Rated Hp. and R.P.M. at Sea Level	Maximum Hp. and R.P.M. at Sea Level	Weight Dry Without Hub or Starter	Weight per Rated Hp.	Bore and Stroke (in.)	Compression Ratio	B.M.E.P.	Displacement (cu.in.)	Frontal Area (sq. ft.)	Diameter of Mounting Ring or Distance Between Bearers (in.)	Height or Overall Diameter (in.)	Length Without Starter (in.)	Guaranteed Fuel Consumption at Rated Hp. Lb.Hp.Hr.	Oil Consumption Lb. Hp. Hr.	Valve Mechanism	Cylinder Construction (See Footnote)	No. Intake Valves per Cylinder	Make Spark Plugs Supplied with Engine	No. Exhaust Valves per Cylinder	Type of Ignition	Make Ignition	No. Carburetors	Make Carburetors	Make Starter	Are Exhaust Manifolds Provided	Shipping Weight Crated	Dept. of Commerce License Number	Price at Factory
Allison Engineering Co.	V1410	A	IV-45°	12	4	D	410–1800	430–1900	1000	2.44	4⅝x7	5.3	128	1410	....	17	46¾	78½	.55	.03	ohc	Al, S	1	BG	1	2B	De	1	Sg	Ec	....	....	Y	.....
Allison Engineering Co.	V1650	W	IV-45°	12	4	D	420–1700	450–1800	885	2.10	5 x7	5.4	122	1650	....	17	46 7/16	74½	.53	.025	ohc	S	1	BG	1	2B	De	2	Sg	Ec	....	....	Y	.....
American Cirrus Engines	Cirrus	A	L	4	4	D	90–2100	95–2100	270	3.0	4⅜x5½	5.4	122	310	....	21 17/64	36⅜	38½	.55	.021	prr	Al, S	1	AC	1	2M	Sc	1	Sg	Op	No	530	30	1,195
Axelson Aircraft Engine Co.	Axelson B7R	A	Rad	7	4	D	150–1800	....	420	2.80	4½x5½	4.7	....	612	....	19¼	45½	35	.52	.017	prr	Al, S	1	RB	1	M	Sc	1	Sg	SA	....	750	16	2,900
Brownback Motor Lab., Inc.	Tiger-100	A	Rad. 8	6	4	D	90–1700	105–1890	264	2.6	4.13x5	5.0	105	397	....	13	37	29¼	.52	.011	prr	Al, NI	1	Ch	1	2M	BR	1	Sg	Op	Yes	497	33	1,295
Chevolair Motors, Inc.	D-4	A	L	4	4	D	90–2000	115–2300	345	3.8	4⅝x5½	5.5	120	352	1.8	.....	28	39	.52	.03	ohc	.....	2	....	2	2M	BR	2	Sg	Op	Yes	....	35	1,850
Chevolair Motors, Inc.	D-6	A	L	6	4	D	165–2175	175–2350	435	2.61	4⅝x5½	5.5	118	529	1.8	.....	28	58	.55	.030	ohc	Al, S	2	Op	2	2M	RB	2	Sg	Op	Yes	....	56	2,500
Comet Engine Corp.	Comet	A	Rad	7	4	D	165–1900	....	400	2.42	4½x5½	5.2	112	612	....	17½	48½	35⅝	.53	.015	prr	Al, S	1	AC	1	2M	Sc	1	Sg	Bs	....	775	47	2,700
Continental Aircraft Engine Co.	A70	A	Rad	7	4	D	165–2000	183–2200	430	2.60	4⅝x4⅝	5.4	122	544	6.9	20	41¾	37 15/16	.55	.03	prr	Al, S	1	AC	1	2M	Sc	1	Sg	Op	Yes	875	32	2,700
Curtiss Aeroplane & Motor Co.	OX-5	W	V-90°	8	4	D	90–1400	....	375	4.17	4 x5	4.9	....	502	....	12⅞	....	....	.55	.030	prr	Mo, C	1	AC	1	1M	....	1	Z	....	No	....	Y	.....
Curtiss Aeroplane & Motor Co.	Conquerer	W	V-60°	12	4	D	600–2400	635–2450	760	1.26	5⅛x6¼	5.8	130	1569	....	15¾	....	56¾	.52	.015	ohc	Al, Al, S	2	BG	2	1M	Sp	2	Z	Ec	No	1060	6	.....
Curtiss Aeroplane & Motor Co.	Gd. Conquerer	W	V-60°	12	4	G²	600–2400	625–2450	850	1.42	5⅛x6¼	5.8	128	1569	....	15¾	....	56 5/32	.52	.015	ohc	Al, Al, S	2	BG	2	1M	Sp	2	Sg	Ec	No	1150	7	.....
Curtiss Airplane & Motor Co.	Challenger	A	Rad, 8	6	4	D	170–1800	180–1800	420	2.47	5⅛x4⅞	5.2	124	603	....	19	41¾	35 5/32	.55	.020	prr	Al, S	1	BG	1	2M	Sc	1	Sg	Ec	No	850	5	.....
Dayton Airplane Engine Co.	Bear	A	L	4	4	D	110–1550	120–1800	375	3.41	4½x7	5.3	118	445	....	16	38⅝	54 27/32	.525	.0125	ohc	Al, NI	1	BG	1	2M	BR	1	Z	N	No	550	11	1,450
Irwin Aircraft Co.	Irwin 79	A	Rad	4	2	D	20–1700	25–2200	57	3.00	2¾x2¾	4.8	105	79	....	10	23	18	.50	.0311	Au	As, Aa, S	1	RB	1	1M	BR	2	Wf	....	No	100	N	550
Jacobs Aircraft Engine Co.	Jacobs LA-1	A	Rad	7	4	D	150–2000	165–2200	390	2.60	4.5x4.75	4.8	....	528	....	.....	44	23	.55	.017	prr	Al, S	1	Ch	2	2M	Sc	1	Sg	Hd	Yes	550	31	2,500
Kinner Airplane & Motor Corp.	K-5	A	Rad	5	4	D	100–1810	105–1900	280	2.80	4.25x5.25	5.0	118	372	....	14	44⅝	32 1/16	.60	.015	prr	Al, S	1	BG	1	2M	Sc	1	Sg Hy	Hd	No	580	3	1,800
Kinner Airplane & Motor Corp.	B-5	A	Rad	5	4	D	125–1925	127–1950	295	2.4	4⅝x5¼	5.2	117	441	....	14	45¾	32 1/16	.60	.010	prr	Al, S	1	BG	1	2M	Sc	1	Sg Hy	Hd	Yes	595	51	2,270
Kinner Airplane & Motor Corp.	C-5	A	Rad	5	4	D	210–1900	245–2200	420	2.0	5⅝x5¾	5.2	122	715	....	19¼	50	34 13/16	.60	.015	prr	Al, S	1	BG	1	2M	Sc	1	Sg	Ec	Yes	950	62	3,000
Kimball Aircraft Corp.	Beetle, Model K	A	Rad	7	4	D	135–1850	150–2000	370	2.74	4½ x5¼	5.2	100	585	....	17	45	37¾	.54	.015	prr	Al, S	1	BG	1	2M	Sc	1	Sg	Ec	No	550	34	2,300
Lambert Aircraft Engine Corp.	Velie M-5	A	Rad	5	4	D	165–2000	....	370	2.46	5 x5½	5.0	....	540	....	19¼	45	28 29/32	.55	.035	prr	Al, S	1	Ch	1	2M	Sc	1	Z	Ec	Yes	420	4	1,050
Lambert Aircraft Engine Corp.	R-266	A	Rad	5	4	D	90–2375	....	214	2.37	4¼x3¾	5.5	113	....	....	.....	33	30¾	.58	....	prr	Al, NI	1	Ch	1	2M	Sc	1	Sg	Ec	Yes	400	38	1,460
LeBlond Aircraft Eng. Corp.	5-DE	A	Rad	5	4	D	70–1950	75–2075	235	3.35	4½x3¾	5.4	116	250	....	.....	.....	33¼	22¼	.58	.015	prr	C	1	.....	1	DM	RB	1	Hy	Ec	No	460	48	1,230
LeBlond Aircraft Eng. Corp.	5-DF	A	Rad	5	4	D	85–2125	90–2250	219	2.57	4¼x3¾	5.4	119	266	....	.....	.....	33¼	22¼	.52	.015	prr	Al, S	1	.....	1	DM	RB	1	Hy	Ec	No	450	46	1,400
LeBlond Aircraft Eng. Corp.	7-DF	A	Rad	7	4	D	110–2150	119–2275	275	2.50	4¼x3¾	5.4	113	372	....	.....	.....	33¼	23 1/16	.54	.015	prr	Al, S	1	.....	1	DM	Sc	1	Hy	Ec	No	490	52	2.160
Light Mfg. and Foundry Co.	BrownbackC400	A	Rad	6	4	D	90–1700	....	278	....	4.13x5	4.8	....	397	....	13	37	29¼	....	....	....	.....	....	....	....	2M	BR	1	Sg	....	....	....	33	.....
Lycoming Mfg. Co.	R-680	A	Rad	9	4	D	210–2000	....	480	2.26	4⅝x4½	5.2	123	680	....	19¼	43¼	32⅝	.55	.025	prr	Al, S	1	BG	1	Sid	Sc	1	Sg	Ec	Yes	875	42	.....
Mac Clatchie Mfg. Co.	Panther	A	Rad	7	4	D	150–1900	160–2000	458	3.00	4½x5½	5.0	120	612	....	17½	36	36½	.56	.006	Lh	Al, S	1	BG	1	2M	Sc	1	Sg	Op	Yes	775	49	.....
Glenn L. Martin Motors Co.	D-333	A	IL	4	4	D	100–200	110-2100	2.80	2.8	.....	5.3	....	333	....	11	29	45	.51	....	ohc	Al, S	1	AC	1	2M	....	1	Z	Op	No	500	59	.....
Menasco Motors, Inc.	Pirate, B-4	A	IL	4	4	D	95–2000	100–2250	280	2.95	4½x5¼	5.5	115	326	2.6	11⅛	28	47¾	.54	.006	prr	Al, NI	1	Ch	1	2M	Sc	1	Sg	Ec	No	430	65	1,560
Menasco Motors, Inc.	Pirate-C-4	A	IL	4	4	D	125–2175	135–2500	275	2.3	4¾x5¼	6.5	125	363	2.6	11⅛	28	47¾	.50	.027	prr	Al, NI	1	BG	1	2M	Sc	1	Sg	Ec	No	430	....	1,860
Menasco Motors, Inc.	Buccaneer-A-6	A	IL	6	4	D	160–1975	180–2500	365	2.2	4½x5¼	5.5	130	489	2.6	11⅛	28	59¼	.54	.006	prr	Al, NI	1	Ch	1	2M	RB	1	Sg	Ec	No	570	....	2,475
Michigan Aero Engine Co.	Rover	A	LI	4	4	D	75–1975	86–2200	228	3.25	4.125x5	5.1	112.5	267	....	14	31⅞	37½	.55	.018	prr	Al, NI	1	AC	1	2M	Sc	1	Sg	N	Yes	370	37	1,200
Packard Motor Car Co.	3A-1500	W	V-60°	12	4	D	600–2500	650–2700	760	1.26	5⅜x5½	5.5	140	1530	4.03	15⅜	38 15/64	62 11/32	.52	.015	ohc	S	2	BG	2	2M	Sc	2	Sg	Ae	No	1275	Y	12,000
Packard Motor Car Co.	3A-2500	W	V-60°	12	4	D	800–2000	835–2100	1160	1.45	6⅜x6½	5.7	135	2539	4.8	18¼	36½	69¾	.52	.015	ohc	S	2	BG	2	2M	Sc	2	Sg	Ae	No	2150	19	15,625
Packard Motor Car Co.	DR-980	A	Rad	9	4	D	225–1950	....	510	2.26	4 13/16x6	14.	93	982	....	22	45 1/16	36¾	.46	.04	prr	S	1	.....	1	Com	....	....	.....	Ec	No	975	43	4,0 5
Pratt & Whitney Aircraft Co.	Wasp C	A	Rad	9	4	D	420–2000	450–2100	715	1.7	5¾x5¾	5.2	124	1344	....	23⅜	51½	42 9/16	.55	.035	prr	Al, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1150	14	7,200
Pratt & Whitney Aircraft Co.	Wasp CG	A	Rad	9	4	G⁴	425-2050	.....	775	1.8	5¾x5¾	5.2	119	1344	....	23⅜	51½	48	.60	.035	prr	Al, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1300	55	8,200
Pratt & Whitney Aircraft Co.	Wasp CG	A	Rad	9	4	G²	420–2100	.....	775	1.8	5¾x5¾	5.2	119	1344	....	23⅜	51½	47	.60	.035	prr	Al, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1300	....	8,200
Pratt & Whitney Aircraft Co.	Wasp SC	A	Rad	9	4	D	450–2100	.....	715	1.6	5¾x5¾	5.2	125	1344	....	23⅜	51½	42 9/16	.55	.035	prr	Al, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1150	58	7,200
Pratt & Whitney Aircraft Co.	Hornet A-2	A	Rad	9	4	D	525–1900	.....	795	1.5	6⅛x6⅜	5.0	130	1690	....	23⅜	55 7/16	44¼	.55	.035	prr	Al, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1400	15	7,800
Pratt & Whitney Aircraft Co.	Hornet A-2G	A	Rad	9	4	G²	500–1900	.....	845	1.7	6⅛x6⅜	5.0	123	1690	....	23⅜	55 7/16	50 1/32	.60	.035	prr	Al, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1475	29	8,800
Pratt & Whitney Aircraft Co.	Hornet B	A	Rad	9	4	D	575–1950	.....	830	1.4	6¼x6¾	5.0	125	1860	....	23⅜	56 15/16	44 13/16	.55	.035	prr	Al, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1450	28	7,960
Pratt & Whitney Aircraft Co.	Hornet BG	A	Rad	9	4	G³	550–1950	.....	885	1.6	6¼x6¾	5.0	120	1860	....	23⅜	56 15/16	67⅞	.60	.035	prr	Al, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1600	....	8,960
Pratt & Whitney Aircraft Co.	Wasp Jr.	A	Rad	9	4	D	300–2000	.....	560	1.8	5 3/16x5 3/16	5.0	120	985	....	23⅜	45¾	41 1/16	.55	.035	prr	Al, S	1	BG	1	2M	Sc	1	Sg	Ec	Yes	1025	39	4,860
Szekely Aircraft & Eng. Co.	SR-3 Mod. 0	A	Rad	3	4	D	45-1750	46–1750	152	....	4¼x4¾	5.0	....	191	....	.....	36	23	.55	.014	prr	Al, C	1	RB	1	2M	RB	1	Sg	No	....	214	.....	.....
Szekely Aircraft & Eng. Co.	SR-3 Mod. L	A	Rad	3	4	D	30-1750	36–1750	152	....	4¼x4¾	4.8	....	191	....	.....	30	23	.57	.014	Lh	Al, C	1	RB	1	2M	RB	1	Sg	No	....	214	53	.....
Warner Aircraft Corp.	Scarab Jr.	A	Rad	5	4	D	90-2025	.....	230	2.7	4¼x4¼	5.2	....	301	....	17	36¼	29	.55	.020	prr	Al, S	1	AC	1	2M	Sc	1	Hy	Op	No	....	54	.....
Warner Aircraft Corp.	Scarab	A	Rad	7	4	D	110–1850	120–1925	270	2.45	4¼x4¼	5.2	112	422	....	17	35½	27½	.50	.01	prr	Al, S	1	AC	1	2M	Sc	1	Sg	Op	No	....	2	2,485
Wright Aeronautical Corp.	Whirlwind 5	A	Rad	5	4	D	165–2000	180–2000	395	2.26	5 x5½	5.1	132	540	....	19¼	45	40⅝	.55	.025	prr	Al, S	1	BG	1	2M	Sc	1	Sg	....	Yes	905	23	3,000
Wright Aeronautical Corp.	Whirlwind 7	A	Rad	7	4	D	240–2000	252–2000	460	1.82	5 x5½	5.1	132	756	....	19¼	45	40 29/32	.55	.025	prr	Al, S	1	BG	1	2M	Sc	1	Sg	....	Yes	975	26	3,900
Wright Aeronautical Corp.	Whirlwind 9	A	Rad	9	4	D	300–2000	325–2000	535	1.80	5 x5½	5.1	132	975	....	19¼	45	41 7/16	.55	.025	prr	Al, S	1	BG	1	2M	Sc	1	Sg	....	Yes	1050	21	4,800
Wright Aeronautical Corp.	Whirlwind J-5	A	Rad	9	4	D	220–2000	255–2000	500	2.50	4½x5½	5.2	123	788	....	19¼	45	33¾	.55	.035	prr	Al, S	1	AC	1	2M	Sc	1	Sg	....	No	1000	13	3,900
Wright Aeronautical Corp.	Cyc.R,1750-E	A	Rad	9	4	D	525–1900	552–2000	825	1.57	6 x6⅞	5.1	130	1750	....	23⅜	54 11/16	43 27/32	.55	.025	prr	Al, S	1	BG	1	2M	Sc	1	Sg	....	Yes	1625	17	7,000
Wright Aeronautical Corp.	Cyc. R,1820-E	A	Rad	9	4	D	575–1900	605–2000	835	1.45	6⅛x6⅞	5.1	138	1823	....	23⅜	54 11/16	43 27/32	.55	.025	prr	Al, S	1	BG	1	2M	Sc	1	Sg	....	Yes	1635	61	7,18
Wright Aeronautical Corp.	Gypsy L-320	A	L	4	4	D	90–1950	100–2100	285	3.16	4½x5	5.0	....	318	....	11 1/16	34 9/16	43 7/32	.55	.010	prr	Al, C	1	AC	1	2M	Sc	1	Sg	Ec	Yes	500	40	1,36

A— Air cooled
Aa— Aluminum alloy
Al— Aluminum
B— Battery ignition
RB— Robert Bosch
Bs— Scintilla booster magneto
C— Cast iron

Ch— Champion
Com—Compression
D— Direct
De— Delco
Du— Duplex
Dx— Dixie
DM—Dual Magneto

Ec— Eclipse
G— Geared
G¹ 5:3 epicyclic gear
G²— 2:1 reduction gear
G³— 3:2 reduction gear
GE— General Electric
H— Hexagonal

Hd— Heywood
Hy— Holley
I— Inverted
L— Cylinders in line
Lh— "L" head
Mo— Monel
M— Magneto

NI— Nickel Iron
Op— Optional
O— Own
ohc— Overhead cam
prr— Push rods and rocker arms
Rad— Radial
Rad S— Staggered Radial

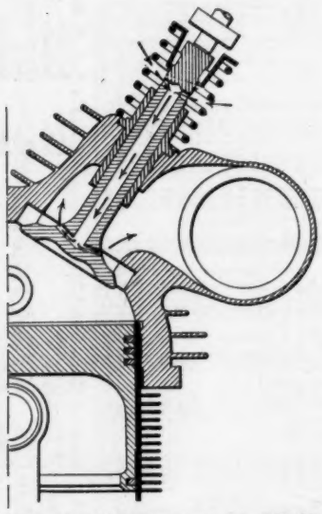
S. A. E.—S. A. E. Mounting
Sc— Scintilla
Sid— Scintilla—Dual Magneto
Sg— Stromberg
So— Solex
Sp— Splitdorf

S— Steel
U— U. S. L. Electric
W— Water cooled
Wf—Winfield
Z — Zenith

Note: Cylinder Construction: first symbol designates head, second—walls or waterjacket, and third—sleeve, if any

Transport and Engineering

FLIGHT TEST ON THE FRIEDL EXHAUST VALUE COOLING SYSTEM



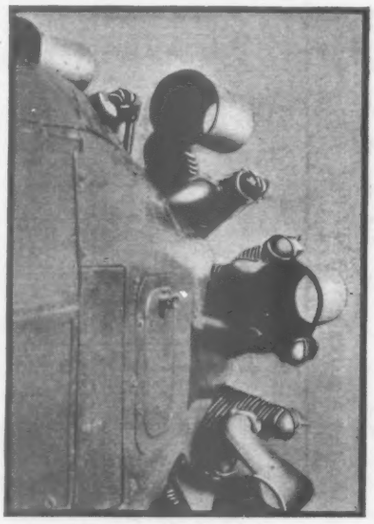
Cross-section drawing of Friedl exhaust valve installed in engine

CONSIDERABLE interest has been aroused among operators of air-cooled aircraft engines by the results of a series of tests made by the Boeing School of Aeronautics on a new system for cooling exhaust valves developed by Ralph Friedl, refrigeration engineer of Oakland, Cal. The new valves were installed on a number of standard air-cooled engines used in regular student training, and after several hundred hours of flying, there was no evidence of exhaust valve trouble, and engine performance had been notably improved.

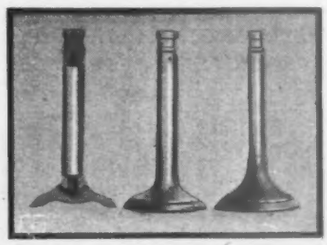
In the case of a standard Boeing 40-B mail plane equipped with a Pratt & Whitney Wasp engine, the full throttle engine speed on the ground was increased by 90 r.p.m., and in the air by 125 r.p.m. above the performance determined with standard valve equipment. The speed of the plane was increased 3 m.p.h. at full throttle, climb performance was materially improved, and the acceleration of the engine was quicker and more positive. It was noted also that exhaust noise was decreased, and that flame in the exhaust stacks was practically eliminated. The new system replaced the conventional exhaust collector ring and resulted in a saving of weight of 56½ lb.

In the Friedl system the exhaust valves are cooled by a flow of air through the hollow stem of the valve. The cooling air enters the valve stem at the tappet-end and is discharged into the cylinder exhaust port immediately under the head of the valve. The construction of the valve and the arrangement of the air passages are clearly shown in the accompanying sketch and photograph. It is to be noted that the holes in the tappet-end of the stem have a smaller cross sectional area than the bore of the valve stem, and also that the combined area of the cooling air exhaust ports under the head of the valve is greater than the cross-sectional area of the bore. This relationship of areas is important as the induced air is continually expanding on its way through the valve stem. This expansion absorbs consdierable heat and is important in the cooling of the valve.

In order to induce a positive flow of cool air from the tappet-end to the head-end of the valve, a difference in pressure must be maintained between those two points. This is accomplished in the Friedl system both by increasing the normal pressure in the rocker box (from which the cooling air is drawn), and by lowering the pressure in the engine exhaust port. A small air scoop at the top of each rocker box provides positive pressure at the tappet-end, and an individual Venturi exhaust stack mounted on the cylinder exhaust port provides the suction required under the head end of the valve. Tests have indicated that at a flying speed of approximately 100 m.p.h., it is possible to maintain an average vacuum of 12 in. of water in the exhaust passage despite the discharge of the exhaust gases into the manifold at every fourth stroke of the cycle. Seventy-five per cent of the time (or during that portion of the cycle when the exhaust valve remains closed), the cooling air is free to flow through the valve stem from the rocker box to the head-end. When the exhaust valve is opened, however, the pressure in the exhaust passage rises considerably, but there is no evidence of back pressure in the valve stem itself as the air discharge openings under the valve head are so arranged that advantage is taken of the high velocity of the gases passing them to maintain a negative pressure in the valve stem. Aside from their primary purpose of assisting valve cooling, the Venturi type exhaust stacks have resulted in improvement in engine performance due to the more complete scavenging of exhaust gases.



Installation of venturi exhaust stacks on radial engine



Construction, and appearance of valves after test; left, exhaust valve sectioned to show air passages; center, appearance of Friedl exhaust valve after test run of 45 hr. (unretouched); right, intake valve taken from same cylinder after same test run. (color indicates intake valve ran hotter than exhaust valve in same cylinder.)

Extreme temperature differences which would result from the impinging of cold air on highly heated metal with the resulting tendency toward valve warpage are avoided due to the fact that the cooling air enters at what is normally the coolest portion of the valve and progresses through the stem toward the hottest parts. It has been found that a constant temperature reduction takes place throughout the valve and tests have shown that it is practical to operate an engine indefinitely at full throttle without danger of exhaust valve trouble due to overheating or warping. In fact, extended operation tests have shown that the valve temperature never ex-

ceeds 1,000 deg. F. It will be noted also that the cooling air leaving the valve is directed against the valve seat and materially aids in regulating its temperature. The possibility of overheating a valve due to the plugging of air passages by particles of foreign material is remote, as all passages are of ample size, and the constant oscillation of the valve would tend to dislodge any particles that found their way in.

Exhaust valves have been taken from an engine after 45 hr. of operation with the valve head still showing sufficient polish so that a reflection could be seen in it. At one time a plane whose engine was equipped with the Friedl valve cooling system was accidentally flown into the cold waters of San Francisco Bay with power full on so that the cold salt water was instantaneously sucked into the cylinders. When the engine was raised and examined it was found that the valve showed no evidence of warping or damage of any sort.

Friedl valves are manufactured by the Aerochrome Engine Valve Company, Ltd., of Oakland, Cal., under patent No. 1,726,217 issued to Ralph M. Friedl, the inventor. The valves are available to any engine builder who wishes to install the Friedl cooling system under license arrangements or they may be built by the engine makers themselves. —T. LEE, JR., *general manager, Boeing School of Aeronautics.*

CEILING ESTIMATION AND DESIGN PROGRESS

IN the January, 1931, issue of AVIATION, the performance formulas derived by Edward P. Warner in 1922 for estimating the maximum speed of airplanes were discussed with relation to the performance of present day machines. In the present article his formula for the calculation of absolute ceiling in terms of wing, and power loading will be similarly treated.

The absolute ceiling for any airplane is that altitude at which the power required for level flight is equal to the power available at the propeller. Ceiling formulas are necessarily somewhat more complex than formulas for the estimation of minimum or maximum speed as they involve airplane weight, power, and area, and must also take into account the rate at which engine power and air density drops off with increasing altitude. A theoretical study of these relationships led to a general equation of the form

$$H = K_1 \log_{10} \frac{K_2}{\frac{W}{P}\sqrt{\frac{W}{S}}} \qquad (1)$$

where H is the absolute ceiling in feet; W the weight of the airplane in pounds; P the available horse power; S the area of supporting surfaces in square feet; and K_1 and K_2 are constants which must be determined experimentally. For this purpose ceiling data for some 48 airplanes of widely varying types were obtained and plotted against the expression $\frac{W}{P}\sqrt{\frac{W}{S}}$, using semi-logarithmic paper. A line was drawn which best fitted the distribution of points plotted, and the mathematical expression for the curve was calculated. This yielded values of 40,000, and 88 for K_1 and K_2 respectively. Substituting in Equation 1, the formula for absolute ceiling in terms of wing, and power loading becomes:

$$H = 40{,}000 \log_{10} \frac{88}{\frac{W}{P}\sqrt{\frac{W}{S}}} \qquad (2)$$

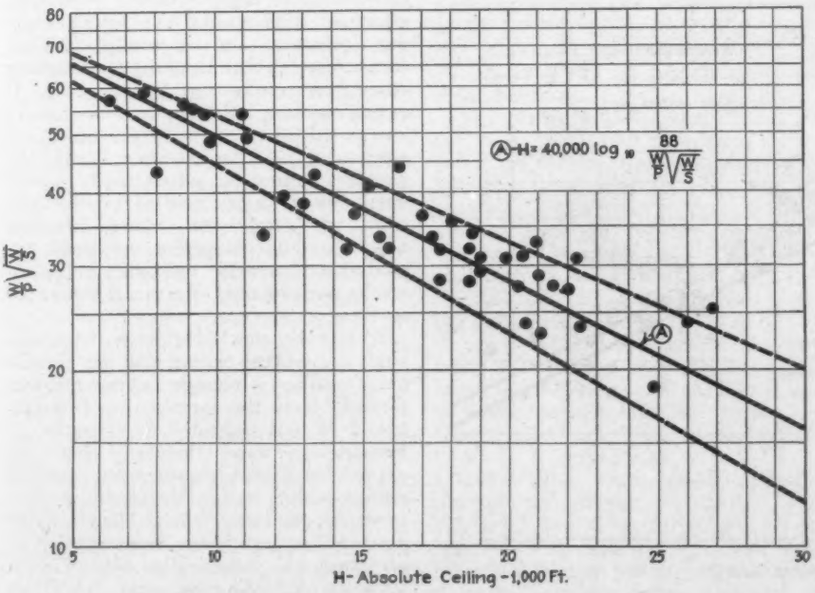


Fig. 1: Airplane Loading vs. Absolute Ceiling (data of 1922)

Fig. 1 shows the distribution of the 1922 ceiling data, and the resulting curve. The dotted lines above and below the solid curve represent a limiting variation of plus or minus 10 per cent. The average error of the points plotted was 12.6 per cent. It will be observed that the points are more widely scattered from the average curve than was the case in the derivation of the maximum speed formula, but this is to be expected, as it is not only more difficult to calculate the effect of the larger number of factors involved, but also more difficult to measure accurately the real altitude of an airplane above sea level.

In order to check the agreement between present day machines and the original formulas a study was made of a relatively large number of Army, Navy, and commercial airplanes. For the service types, Army and Navy performance data, corrected to Jan. 1, 1930, were used. The information on commercial machines was obtained from the airplane specification table, published by AVIATION in November, 1930.

The data from the two sources have been plotted on separate charts. Fig. 2 includes 125 Army and Navy airplanes of all types, identified on the charts through the use of distinctive symbols. The solid line in Fig. 2 is the same as that of Fig. 1 and corresponds to Equation 2. Although the distribution of points is somewhat scattered, it was apparent that the majority of the points fell somewhat above the curve. A number of trial curves were plotted, and the one which seemed to fit the conditions best is shown on the chart as a dotted line. The new curve has the slope of the original curve but yields somewhat higher altitudes for the same wings, and power loading. The formula corresponding to the new curve is as follows:

$$H = 40{,}000 \log_{10} \frac{95}{\frac{W}{P}\sqrt{\frac{W}{S}}} \qquad (3)$$

It will be noted that the widest deviations from the average curve occur in those machines having relatively low absolute ceiling. This group is made up almost entirely of large bombers, transports, flying boats, and amphibions.

It is logical that the change should come in the numerator of the fraction, rather than in the coefficient 40,000, for the former depends on the inherent efficiency of the airplane, while the latter is affected only by the rate at

which engine power output varies with altitude. The change from Equation 2 to form 3 shows, better than any other data that could be collected, the change of inherent aerodynamic efficiency. It appears that the average military or naval airplane has increased its "fineness" under climbing conditions about eight per cent in eight years, not a very spectacular progress.

As was discovered when plotting the high speed characteristics of commercial airplanes, performance results reported by manufacturers tend to be much less consistent than those reported for Army and Navy machines. This variation is not totally unexpected, not only because of the widely varying conditions under which commercial airplanes are tested, but also from the influence of commercial competition. Fig. 3 shows the result of the study on 75 commercial airplanes of varying types. These data alone would scarcely furnish sufficient basis for the determination of the slope or location of an average curve. The best that could be done, therefore, was to compare the points plotted with the curve determined from Figures 1 and 2. Assuming the accuracy of the data, it was apparent that the majority of the points fell above the modified curve obtained from the Army and Navy performance figures. Using the same slope, curve *C* was drawn which seems to represent a fair curve for the points as they fell. The mathematical expression for this curve is as follows:

$$H = 40{,}000 \log_{10} \frac{103}{\frac{W}{P}\sqrt{\frac{W}{S}}} \qquad (4)$$

In considering the three curves of Fig. 3, there is some question as to whether the use of curve *C* can be justified. It undoubtedly fits the points as plotted better than does curve *B* but it is quite obvious that many of the points are merely manufacturers' estimates and not the result of careful testing. This is indicated by the fact that there is a decided tendency for relatively large numbers of the tests to fall exactly on what might be termed "popular" altitudes. Attention is called to the concentration of points at 15,000, 16,000 and 18,000 ft. It is not unreasonable to suspect that these good round numbers often represent designers' hopes rather than the result of accurate tests, subject to consistent reproduction. Reference to Fig. 2 shows much less tendency for points to collect at certain values of *H*, and it is probable that they are actual figures from carefully conducted tests on individual machines.

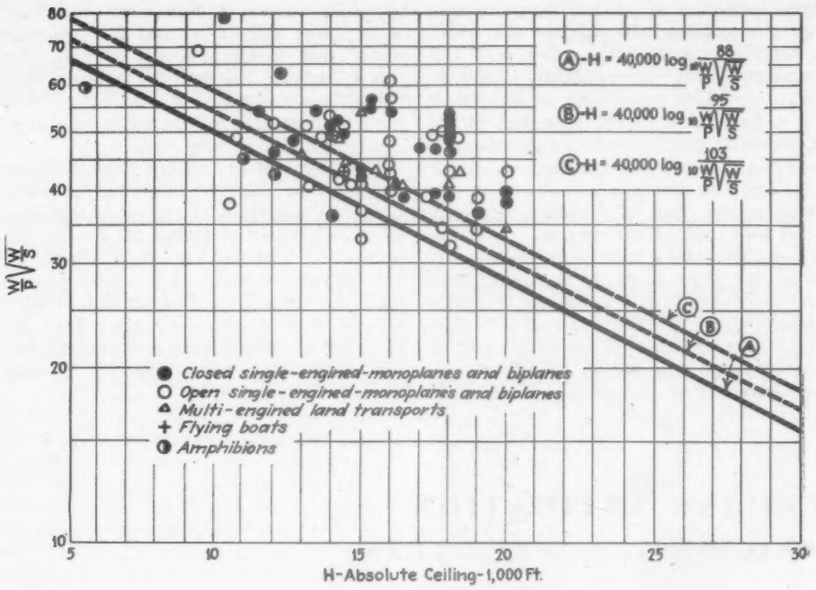

Ⓐ-H = 40,000 log 88 / (W/P √(W/S))
Ⓑ-H = 40,000 log 95 / (W/P √(W/S))
Ⓒ-H = 40,000 log 103 / (W/P √(W/S))
● Closed single-engined-monoplanes and biplanes
○ Open single-engined-monoplanes and biplanes
△ Multi-engined land transports
+ Flying boats
◑ Amphibions
W/P √(W/S)
H-Absolute Ceiling-1,000 Ft.

Fig. 3: Airplane Loading and Absolute Ceiling (commercial data of 1930)

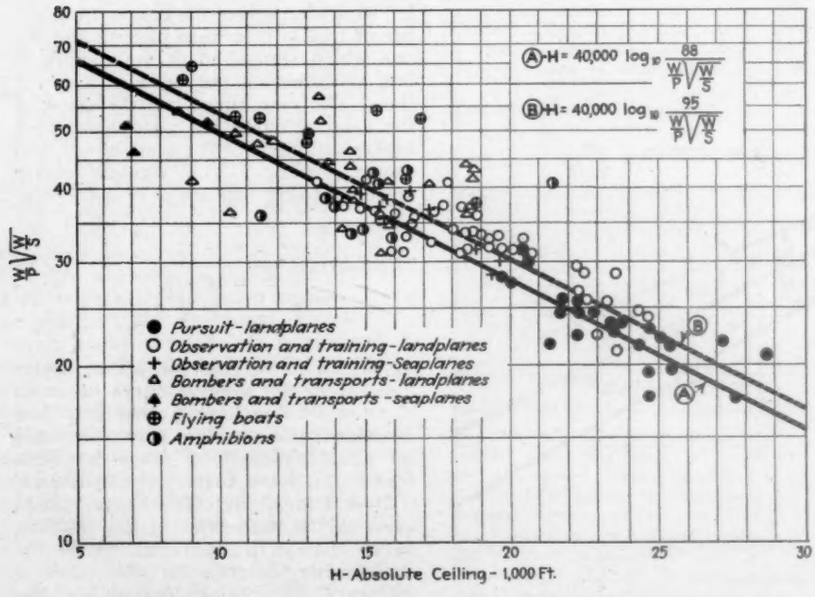

Ⓐ-H = 40,000 log 88 / (W/P √(W/S))
Ⓑ-H = 40,000 log 95 / (W/P √(W/S))
● Pursuit-landplanes
○ Observation and training-landplanes
+ Observation and training-Seaplanes
△ Bombers and transports-landplanes
▲ Bombers and transports-seaplanes
⊕ Flying boats
◑ Amphibions
W/P √(W/S)
H-Absolute Ceiling-1,000 Ft.

Fig. 2: Airplane Loading and Absolute Ceiling (Army and Navy data of 1930)

In making a study of airplane performance data, as was necessary for the preparation of this and the previous article, one feature that must be apparent even to the most casual investigator is the consistent inconsistency of results reported by manufacturers for their products. This cannot be simply dismissed as indicating baseless, or even dishonest claims on the part of the manufacturers, as the majority of them certainly make reasonable efforts to check the performance of their machines. Anyone familiar with the difficulties encountered in airplane performance testing, however, realizes the complexity of the problem, and the difficulty of reducing observed data to standard conditions. It is only through the efforts of highly trained personnel, equipped with special equipment, making repeated and carefully checked measurements that anything approaching consistent results can be attained. It is obvious that individual manufacturers cannot afford to maintain the necessary equipment or organization, and the problem cannot be satisfactorily solved until one or more central testing stations are established where adequate apparatus and competent personnel are available to render unbiased judgment on the performance of aircraft submitted to them.

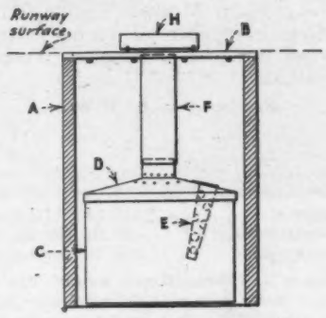
It may be concluded from the above study of airplane ceiling that the present data justifies a change in the original formula from the form given in Equation 2 to that indicated by Equation 3. Bearing in mind the fact that this expression is for purposes of approximation only, and is based on general averages, the latter will yield reasonably good ceiling estimates when applied to airplanes of practically all types.—EDWARD P. WARNER and S. PAUL JOHNSTON.

SMOKE POTS TO INDICATE AIRPORT GROUND WINDS

SMOKE pots for airport wind indicators are now commercially available through United Airports of California, Ltd., Burbank, Calif. The first of these pots was developed by this company for use at their own port and has been in continuous use for several months.

Any shade of smoke may be produced, varying from a white to jet black. The smoke is heavy and tends to roll along the ground, showing the pilot each gust of wind and its velocity.

The unit, which is flush-mounted with the surface of the airport, consists essentially of a cylindrical casing of concrete 3 in. thick, 42 in. deep and 24 in. I. D. The upper end of the cylinder is covered by a grating built up of 1 in. x ¼ in. bars set on edge with a 6x6-in. section left out in the center for the stack, which is a length of 5-in. pipe connecting a circular shield above the grating with the bowl at the bottom of the cylindrical casing. A perforated vent pipe in the bowl is fitted with a sliding cover to permit regulation of draft.



A—concrete casing, B—grating, C—bowl, D—bowl cover, E—vent pipe, F—stack, H—circular shield

The charge used is a cheap grade of fuel oil. The tank holds 25 gal. and will produce smoke 12 to 15 hr. without tending.—AVIATION.

Flying Equipment

MENASCO C-4, A-6, AND B-6 ENGINES

THE award of three new A.T.C.'s to Menasco Motors, Inc., of Los Angeles, Cal., gives that company a total of five approved type certificates for a line of four and six cylinder in-line, inverted, air-cooled aircraft engines.

Menasco engines previously approved were the A-4, A.T.C. 50, developing 90 hp. at 1,925 r.p.m., and the B-4, A.T.C. 65, developing 95 hp. at 2,000 r.p.m. The latter engine was described in the October, 1930, issue of AVIATION, and differs from the A-4 only in the arrangement of accessories at the rear of the crankcase. New approvals are of the C-4, A.T.C. 67, developing 125 hp. at 2,175 r.p.m.; the A-6, A.T.C. 69, 140 hp. at 1,925 r.p.m., and the B-6, A.T.C. 68, 160 hp. at 1,975 r.p.m. The C-4 engine is a further development of the original four cylinder model, and the A-6 and B-6 designs closely follow the four cylinder type, interchangeability of parts between the four and six cylinder engines being approximately 90 per cent.

These five Menasco engines cover a power range at present of from 90 to 160 hp. Although the four cylinder series is rated at from 90 to 125 hp. the C-4 engine has developed a maximum of 135 hp. at 2,500 r.p.m. in torque stand tests and has turned up 2,800 r.p.m. when mounted in racing planes. The six cylinder series is rated at 140 to 160 hp. but the B-6 engine has actually developed 180 hp. at 2,500 r.p.m. in factory tests and with the addition of supercharging, for which the engine has been designed, it is anticipated that its capacity can be increased to more than 200 hp.

The Menasco C-4 engine differs from the B-4, previously described, only in increased piston displacement and compression ratio, and in improved carburetion. Horsepower has been increased from 95 for the B-4 to 125 fro the C-4 with an attendant increase in r.p.m. at rated hp. from 2,000 for the B-4 to 2,175 for the C-4. Retaining the 5⅛ in. stroke of the B-4, the bore of the C-4 has been increased to 4¾ in. from 4½, giving a total piston displacement of 363 cu.in. compared with the B-4 displacement of 326 cu.in. The compression ratio has been increased to 6.5 to 1, from 5.5 to 1.

Carburetion has been improved through use of the Stromberg 1¼ in. NAR-4D downdraft carburetor in conjunction with a new Swan type manifold, both shorter and of larger diameter than the previous design and with the carburetor mounted directly upon the manifold. This use of a downdraft carburetor in connection with a downdraft manifold has made it necessary to provide some form of drain system to take care of any gasoline which might drain into the manifold as a result of excessive choking or long standing. This has been taken care of by drilling a $\frac{3}{32}$-in. hole beneath the rear elbow of the manifold which drains any surplus liquid fuel off automatically through a ¼-in. pipe leading to a point beneath the fuselage. Although this drain hole is always open it has no measurable tendency to lean the mixture reaching the rear cylinder, and is entirely satisfactory for keeping the manifold dry. Although the Swan-type manifold, with its dead ends, is commonly used in automotive work, this is thought to mark its first application to aircraft engine design. The use of the dead end space materially improves the distribution of fuel to the end cylinders by preventing the piling up of liquid gasoline on the end elbows as seems to occur in the conventional type manifold.

Oil jacketing of the intake manifold is not necessary on the downdraft design as the intake air is drawn from the vicinity of the two center cylinders directly after it has been warmed by flowing across them.

Design of the Menasco six cylinder engines closely follows that of the fours, differing materially only in the design of the crankcase, and the arrangement of auxiliary units and their drives, with provision for the installation of a centrifugal supercharger and the direct mounting of an electric starter. Since the A-6 and B-6 engines differ in carburetion only, it will be sufficient to describe the B-6 engine. Developing 160 hp. at 1,975 r.p.m., the Menasco B-6 engine weighs but 365 lb. complete with air scoop, but without propeller hub. The A-6 weighs 370 lb. due to the greater weight of the long manifold used. Cylinders have a bore of 4½ in. and stroke of 5⅛ in. Total piston displacement of the engine is 489 cu.in. Cylinders are interchangeable with the B-4 engine.

Overall length of the engine is 59½ in., height 28 in., and width 15¼ in. The overall length has been kept low through compact mounting of accessories at the rear of the crankcase, while the narrow width of the engine, and the extremely low frontal area compared with other engines of different design but corresponding horsepower, is quite remarkable.

Since the parts of the A-6 and B-6 engines are about 90 per cent interchangeable with the B-4, previously described, the engine will not be described in detail. Cylinders, connecting rods and pistons, valve mechanisms, bearings and bearing caps, oil pump and drive mechanism are all identical with the parts of the B-4 and retain the features of ruggedness, simplicity and durability which have characterized all of the Menasco engines to date. As in the four cylinder models, the B-6 provides improved cooling and lubrication, rapid acceleration throughout the power

range, easy accessibility of all units for rapid servicing, and general "cleanness" of all external portions of the engine.

The main crankcase of the B-6 engine is cast in one piece of aluminum alloy for rigidity. A single cover plate extends along the entire top of the case and a single section is used at the rear to house the accessory drives. The crankshaft is mounted through a circular opening in the nose of the case, the opening being covered by a small plate after the engine is assembled. There are six parabolic transverse ribs of T section cast integral with the main case and supporting the seven main bearings. In addition to the seven bronze backed plain babbitt bearings upon which the crankshaft is mounted a single Norma-Hoffman deep groove ball-bearing is mounted at the forward end of the shaft to take propeller thrust. The hub mounting on the crankshaft is of the splined type, S.A.E. No. 10.

Design of the accessory case, gears, and mounts is of extremely simple type, lending itself to lower manufacturing costs, easier assembly, and quicker servicing. There are but three main gears in the accessory drive chain, one on the main shaft, one on the cam shaft, and an idler between. Engaging dogs for starter use are integral with the driving gear on the main shaft, a standard S.A.E. mount of 5 in. dia. being provided for the direct attachment of Eclipse hand or electric starter. Magneto gears are mounted directly on the magneto drive shafts and engage with the idling gear and camshaft drive gear respectively when the magnetos are mounted to the case. Magnetos are Robert Bosch and operate at 1½ times engine speed. The camshaft gear serves as the drive for the oil pump shaft, engagement being by means of dogs which are integral with the gear. The engine has been designed for the use of a centrifugal type supercharger, designed and built in the Menasco engine factory, which can be mounted directly to the rear case without re-arrangement of any accessories.

Carburetion on the B-6 engine is supplied by a Stromberg NA-DD4 1¼ in. double-throat carburetor of the downdraft type mounted directly to a split type manifold and serving three cylinders from each throat. The A-6 engine carries a Stromberg NA-R5 2 in. updraft carburetor mounted at the rear of the engine and serving the intake manifold through a long downdraft-type stand pipe.

Several sport and training planes are now offering Menasco engines as optional equipment and a number of new planes are being designed around the new six cylinder Menasco engine series, including a number of racing planes projected for the Thompson Trophy race of 1931.

Menasco **C-4, *A.T.C.* 67**

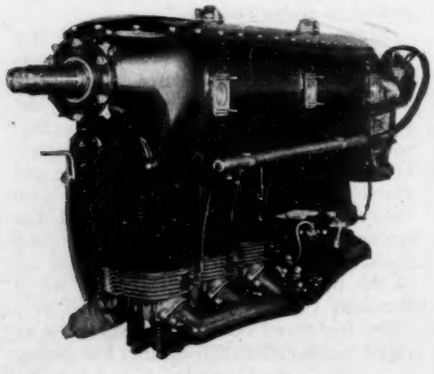
Bore	4⅜ in.
Stroke	5½ in.
Displacement	363 cu.in.
Compression ratio	6.5 to 1
Horsepower	125 at 2,175 r.p.m.
Fuel consumption	.50 lb. per hp. hr.
Oil consumption	0.01 lb. per hp. hr.

Weights and dimensions: weight, 275 lb. with air scoop but without propeller hub; length overall, 45½ in.; height overall, 28¾ in.; width overall, 12½ in.

Menasco **A-6, *A.T.C.* 69; *B*-6, *A.T.C.* 68**

Bore	4½ in.
Stroke	5½ in.
Displacement	489 cu.in.
Compression ratio	5.5 to 1
Horsepower, (A-6)	140 at 1,925 r.p.m.
Horsepower, (B-6)	160 at 1,975 r.p.m.
Fuel consumption	.54 lb. per hp. hr.
Oil consumption	0.002 lb. per hp. hr.

Weights and dimensions: Weight, A-6, 370 lb. with air scoop but without propeller hub; weight, B-6, 365 lb. with air scoop but without propeller hub; length overall, 59¾ in.; height overall, 28 in.; width overall, 15¾ in. Starter and fuel pump mounts provided.



Three-quarter front views (intake sides), of three Menasco engines. The new 125 hp. C-4, 4-cyl. engine (at top) and (left) the new A-6, 140 hp. 6-cyl. model. The B-4, (above) is the 95 hp. model of the 4-cyl. line.

THE WESTBROOK "SPORTSTER"

PRODUCTION has been started on a new light airplane, by the Westbrook Aeronautical Corporation at their factory at 142 West 24th Street, New York City. The machine is a two-place, low-wing monoplane of conventional design intended to fill the needs of the private owner. It is powered with either the Gipsy or the Cirrus engine, which should afford it satisfactory performance.

The fuselage and tail surfaces are of the usual welded steel tube construction, fabric covered. The engine mount is bolted to the fuselage forward of the fire wall, and may be removed as a unit. The under carriage design permits an unusually wide tread and is so arranged that no lateral loads are imposed on the wheels when landing. The wheels pivot about the point of attachment of the rear struts to the fuselage and their forward and vertical travel is controlled by an oleo-leg.

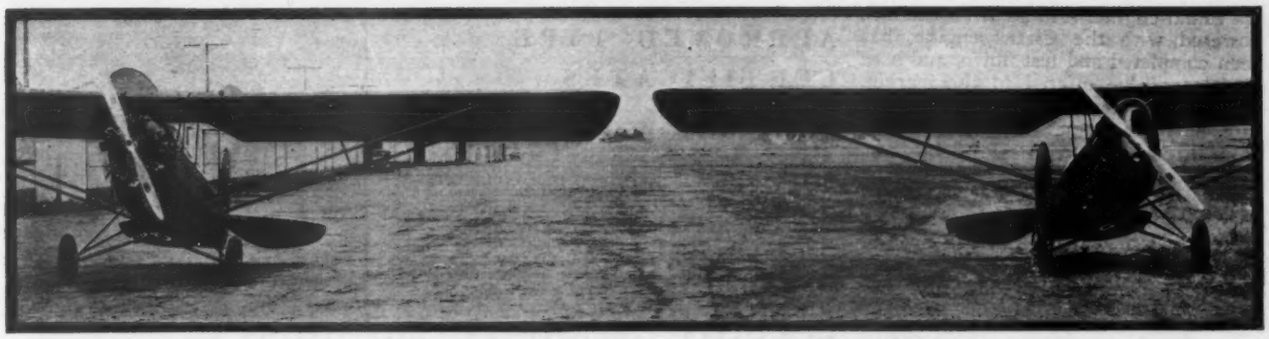
The wings are of the full cantilever type, and are of all-wood construction. They are tapered in plan, and the section is varied from a relatively thick high lift type at the root to a much thinner section, having slight lower camber at the tips. The box-type spars are of spruce, and the ribs and covering are of plywood. A feature of interest to the private owner whose storage space is limited, is the fact that the wings may be folded back along the fuselage. The wing folding process can be completed by two people in a relatively short time, and it is claimed that there is no reduction in strength or rigidity when the wings are fastened in flying position.

The general characteristics and the performance figures for this machine, as given by the manufacturer, are as follows:

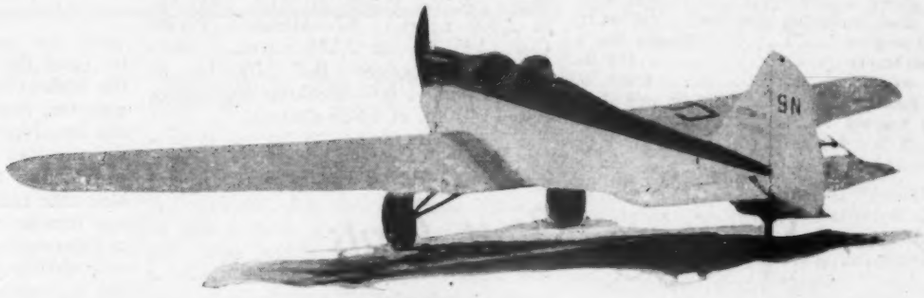
Wing span	32 ft.
Wing area	148 sq.ft.
Overall length	23 ft. 6 in.
Maximum height	6 ft.
Weight empty	900 lb.
Weight full load	1,400 lb.
Fuel capacity	20 gal.
Engine	95 hp. (Cirrus or Gipsy)
Normal cruising range	400 mi.

THE GEE BEE "SPORTSTER"

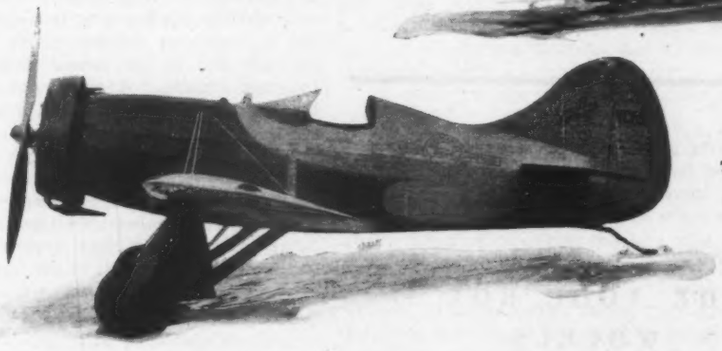
IF aircraft competition on a national scale is to have any economic justification, it must yield tangible results in the form of improvements in design and performance. A case in point is the marketing of the new Gee Bee "Sportster" by Granville Bros. Aircraft, Inc., of Springfield, Mass. This single-seated high performance sport airplane is a direct descendant of the well-known Cirrus powered racer



Two California "Cubs." Left, powered with 90 hp. Lambert engine and right, with a Cirrus



The Westbrook "Sportster"



The Gee Bee "Sportster"

which took second place in the All-America Air Derby last year.

The new machine is a low-wing monoplane with exceptionally clean lines, and is offered with a number of optional power plant arrangements. The photograph illustrates the model powered with the Warner Scarab radial engine of 110 hp., equipped with a Townend ring. Other available power plants are listed in the table below.

The fuselage is of welded chrome-molybdenum steel tube construction with fabric covering. A detachable engine mount permits the installation of practically any inverted four or six cylinder in-line engine, and it can also be adapted for a number of radial designs. The landing gear incorporates both low pressure air wheels and hydraulic shock absorber struts, and special fairing is supplied to reduce the overall wheel drag.

The wings are attached to short wing stubs faired into the fuselage and braced by short diagonal struts. The stubs provide points of attachment for the undercarriage. The wings are tapered in plan to improve maneuverability, and, on account of their relatively thin sections, are externally braced at their mid-points by streamline rods running into the fuselage and to the undercarriage. The spars and rib are of wood, with metal compression struts, and the assembly is internally braced with tie rods. The covering is of fabric.

The general characteristics of this airplane with the various power plant arrangements are tabulated by the manufacturer as follows:

Span	25 ft.
Wing area	95 sq.ft.
Length	17 ft. 3 in.
Height	6 ft.
Fuel Capacity	40 gal.
Oil Capacity	2 gal.

Engine

Model	Engine	Hp.	Weight
B	Supercharged Cirrus Ensign	110	870
C	Menasco B-4	95	820
D	Menasco C-4	125	830
E	Warner Scarab	110	830
F	Fairchild 6-390	135	900

CALIFORNIA "CUB" TRAINER

LIMITED production on the "Cub" two-place parasol monoplane trainer powered with the Lambert 90 hp. engine is announced by the California Aircraft Corporation, Los Angeles, Cal., following granting of a Group II certificate by the Department of Commerce.

The California "Cub" is of conventional construction with rigid truss fuselage of welded steel tubing and wings of wood structure, the entire plane being cloth covered. Ailerons are of wood construction, while all empennage members are built of welded steel tubing. The engine mount is built integral with the fuselage and the engine is mounted to rubber insulated bearing sockets. Wing spars are of solid spruce, with both leading and trailing edges of the wing formed from spruce members. Forming ribs are built with basswood webs and spruce cap strips. Compression rib members are of hollow square section built up from spruce, and single drag wire bracing is used throughout. All control surfaces are pin-hinged and operated by standard cable over pulleys to external horns.

The Cub is unique in the use of a very thin airfoil section, and in the manner of bracing the wing. The section is so thin that conventional strut bracing would lack sufficient rigidity. By using long struts to a point near the wing tips in connection with intermediate members which are wire braced to the fuselage for lift and landing loads, it has been possible to use a thin section to good advantage. The wing is built in three sections, two outer panels, and a center section.

The model approved by the Department is powered with the Lambert 90

hp. radial engine. An additional model, powered with the Cirrus engine, has been completed and test flown, and both models will be offered to the market. Production plans call for the manufacture of these planes in small lots of from three to five with sales being handled direct from the factory. The plane will be of assembled type when placed in production in that as many parts and units as possible will be turned over to specialty manufacturers.

Specifications of the California Cub as supplied by the manufacturer are:

Length overall	23 ft. 10 in.
Height overall	8 ft. 6 in.
Wing span	37 ft. 9 in.
Wing chord	6 ft. 6 in.
Wing area, including ailerons	232 sq.ft.
Airfoil section	Brown No. 4
Weight empty	972 lb.
Gross weight	1,489 lb.
Wing loading	6.4 lb. per sq.ft.
Power loading	16.5 lb per hp.

APPROVED TYPE CERTIFICATES

DURING the period Dec. 20, 1930 to Jan. 14, 1931, the Aeronautics Branch of the Department of Commerce issued the following Group I Approved Type Certificates: 387—Brunner-Winkle Bird C (Wright R-540, 165 hp.); 388—Bird, Bird CK (Kinner B-5, 125 hp.); 389—Spartan C5-301 (P. & W. Wasp, Jr., 300 hp.); 390—Fairchild 100 (Hornet B, 575 hp.).

During the same period certificates were issued on the following engines: 66—P. & W. Wasp, Jr. 31A (400 hp. at 2,300 r.p.m.); 67—Menasco Pirate C-4 (125 hp. at 2,175 r.p.m.); 68—Menasco Buccaneer B-6 (160 hp. at 1,975 r.p.m.); 69—Menasco Buccaneer A-6 (140 hp. at 1,925 r.p.m.).

Servicing Short Cuts

SERVICING AIRCRAFT STARTERS

THE Eclipse Aviation Corporation of East Orange, N. J., has recently marketed two new pieces of service equipment which are of interest to repair shops called upon to maintain hand or electric inertia starters.

A special tool kit has been made available which contains all tools which are required for assembly and disassembly of parts of various starters. Each tool is designed for a specific purpose, and no standard tools are included. The set is put up in a strong container which serves both as shipping case and as a tool cabinet in the shop.

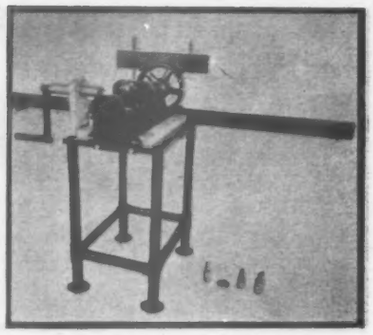
For service stations where repairs on starters other than cleaning are contemplated, a testing stand is offered to assist in properly adjusting the tension on starter clutches. The clutch is a safety device, inserted between the starter mechanism and the engine crankshaft, designed to slip in case engine starting torque becomes excessive for any reason, or in case the engine backfires. It must be adjusted so that the engine will be turned over without slippage under ordinary conditions, but will slip in an emergency. By the use of the clutch testing stand the spring tension may be adjusted to slip at any predetermined value of torque.

The stand will accommodate starters with either 5 in. or 6 in. mounting flanges, designed to rotate in either direction. The cranking brackets can be placed on either side or on the end to take care of various types of starters, and four crank extensions are provided for different types of shafts. Electric starters can also be mounted and operated by a storage battery. The torque is measured by a prony brake and a platform scale.

THE TOOL BOX ON WHEELS

MECHANICS of the Transcontinental and Western Air service hangar, Alhambra, Cal., have shown considerable ingenuity in developing portable tool boxes which may be drawn around the shop on wheels, instead of being carried by hand. This practice increases the efficiency of the individual mechanic to a very considerable degree as it encourages him always to have all of his tools with him as he moves from job to job, saving needless trips back and forth and making it possible for him quickly to handle each individual bit of work.

Although it is perfectly possible to carry the average mechanic's tool box by hand the effort is considerable and the addition of wheels and a handle is a welcome improvement. Each mechanic has developed his own method of making the tool box mobile. One man has provided a three wheel truck using a steerable front wheel with a long steel rod handle. Another used an ordinary child's coaster wagon with the handle extended by sawing it in two and inserting a length of rubber tubing clamped at each end to the sawed ends of the original handle. A third mounted his box on small casters carried in a welded angle iron framework and pulls it around by means of a length of wire cable with a handle on the end of it. Although a homely method in every case the results have been well worth while in actual saving of time and effort and in the improved morale of the mechanics.

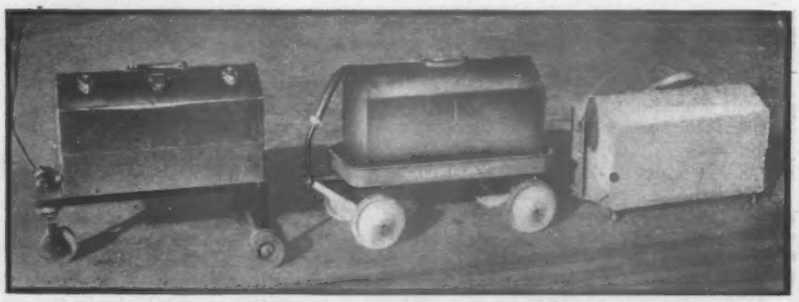


Stand for servicing engine starters

SPRAY BOOTHS IN SHOP WALLS

SHOP space has been materially conserved, and the time required to spray-paint engine cylinders and small parts has been materially reduced in the shops of the Aero Corporation of California by the provision of a small wall booth for spray painting.

An open booth about 8 ft. high, 10 ft. wide, and 6 ft. deep was built into one wall of the shop and equipped with a suction fan at the back of the booth, driven by an electric motor. Cylinders to be enamelled are placed on a turn-



Three tool boxes that can be easily drawn about the shop

table in the center of the booth and turned by the painter who faces into the booth as he sprays the part with paint. This system keeps the shop free of paint fumes, cuts down the hazard of uncontrolled fumes, avoids the necessity of a large closed room or booth for this work, and because of its accessibility to the main shop and ease with which it is used, the painting processes are materially speeded.

Walls of the booth are covered with flat sheet iron to which brown paper is attached by means of a layer of ordinary cup grease. It is a simple matter to occasional strip off the paint covered paper, wash the walls down with kerosene, and re-paper the booth.

Technical Abstracts

PROPELLER TWIST UNDER LOAD

STRESSES AND STRAINS IN AIRSCREWS WITH PARTICULAR REFERENCE TO TWIST; *By R. McKinnon Wood and W. G. A. Perring; British Aeronautical Research Committee R. and M. No. 1274.*

THE designer of an aircraft propeller is able to more accurately calculate its performance if he knows the extent to which the blades twist under running loads. A theoretical treatment of the problem is presented in this report, together with a simplified approximate method suitable for practical design work.

Cross section of the blade change along the radius in shape, in size, and in orientation. The first two variations (taper), do not make the stresses sensibly different from those in a cylinder of the same cross-section as the section under discussion; the last (natural twist) is an important factor in the problem. A naturally twisted strip tends to untwist when subjected to a pure end tension, and the direct tension due to centrifugal force produces an important untwisting effect in an airscrew blade. If the natural twist is not too large, the end load produces a sensibly uniform tensile stress along lines parallel to the nearest boundaries, and the resulting twisting moment is $= \int pbz^2\tau_0 dz = \tau_0 XC/S$, where p is the tensile stress due to the end pull X, b is the thickness of the strip at a distance z from the centroid of a cross-section, τ = the natural twist per unit length, C the moment of inertia $\int bz^2dz$, and S is the cross-sectional area.

It is evident then that in order to calculate the torsion of a blade by considering it a simple cylinder subjected to twisting couples, a quantity $X(C/S)\frac{d\theta}{dr}$ must be added to the true external couples to take account of this untwisting action of the centrifugal force. The calculation is then expressible by the equation:

$$GJ\tau = L_c + L_a + X(C/S)\frac{dr}{L_a}$$

where G is the modulus of rigidity of the material, J is the torsional stiffness of the section, τ is the resultant twist per unit length, L_c is the twisting moment due to centrifugal forces, and L_a is the twisting moment due to aerodynamic forces.

An approximate formula for J for an airscrew section is $J = \frac{1}{3}\int t^3dy$, where t is the thickness at any point and y is measured along the center line of the section.

To find the twisting moment due to the aerodynamic loads, it is necessary to find the flexural axes of the sections. A section of a propeller blade can have only one unstressed fiber and its position is called the "flexural center." The flexural axis is the tangent to the locus of the flexural centers of the section. The position of the flexural center along the chord is that of the centroid of the area under the curve formed by plotting the cube of the thickness at each point along the chord.

For the twisting moment at any section, say *bb*, due to the aerodynamic loads, find the intersection of the flexural axis of this section with the sections *cc*, *dd*, etc., in turn to the tip. Then take moments of the air loads about normal axes through these intersections and so find the contribution of a unit length of blade at each section. Then plot and integrate. The designer will already have had the lift and drag coefficients and centers of pressure of the airfoil sections used, so that this does not entail a great amount of extra work.

To find the centrifugal twisting moment, calculate the value of $\rho_m W^2 C \sin\theta\cos\theta$ at each section, ρ_m being the density of the material, w the angular velocity, C the major moment of inertia, and θ the angle between the major axis of the section and the plane of rotation. This formula is good only if the blades are not tilted relative to the plane of rotation.

To find the moment due to the tension, evaluate for each section the quantity $\rho_m w^2 rS$, where r is the radius, plot against r, and integrate to find the value of X/S at each section. Multiply this by $\frac{dr}{d\theta}$ to find the tension twisting moment, θ being expressed in radians.

The sum of the three quantities thus found should be equated to τJG. The torsion is then plotted along the radius and integrated from the root to a series of sections to obtain the twist at each section in radians.

These formulæ were deduced for solid homogenous blades, but the method is applicable also to hollow blades. For the latter, the torsional stiffness is $J = 4S^2t/p$, if the walls are of uniform thickness t, S being the area contained, and p the perimeter of the section.

THE STRENGTH OF METAL COVERING

METAL COVERING OF AIRPLANES, *by J. Mathar; N.A.C.A. Technical Memorandum No. 592; A translation from Jahrbuch, 1929, der Wissenschaftlichen Gesellschaft für Luftfahrt.*

THE use of sheet metal as covering to take a part of the loads imposed upon aircraft structures has been greatly retarded due to the difficulties encountered in calculating the strength of the plates so utilized. The plates, of thicknesses considered unsafe in other branches of construction, tend to buckle under very slight loads, and not until recently was the problem of buckling investigated. This paper discusses the number of corrugations of a buckling and a buckled plate, and then describes some tests made upon a plate beam.

Theoretical investigations have indicated that for restrained plates the length of the corrugation is 1.6 times the width, while for freely supported plates it is 2.7 times the width. Practically, however, the number of wrinkles or folds varies greatly from the theoretical values, due to inaccuracies caused by edge influences such as riveted joints, and by the rise or existence of additional stresses in the direction of the folds. The basic corrugation, with a length of 1.6 times the width, can be retained only in the exact test, where no initial deformations exist, and where additional stresses in the direction of the folds neither exist nor come into being; otherwise there will be more corrugations.

Tests with rubber models lead to the conclusion that, for plates with low stiffness in bending, the length of corrugation is 1.6 times the width at buckling, although this may be considerably less if both edges of the plate are supported so that their spacing remains constant during the entire test. If the bending stiffness of the plate is zero, the ratio becomes infinitely small.

A glance over the entire structural method of plates shows that a large portion of the problem reverts to the behavior of a beam comprising continuous

struts, thin webs, and vertical members or uprights, such as the walls of a metal fuselage, skin-stressed wing covering, etc. Therefore, tests were made of such a beam with the object of answering:

(a) What is the effect of the number of uprights on the stiffness of a plate wall beam?

(b) What is the effect of riveting the plate to the uprights on the beam stiffness?

(c) What is the effect of gusset plates between uprights and struts? Are they redundant or is the ratio of increased stiffness to increase in weight abnormal?

(d) What is the actual stress distribution in the plate, in the uprights, and in the struts for the beam in question?

The following experiments were made:

(1) The plate was not fastened to the uprights, allowing the ensuing corrugations to continue undisturbed. The uprights were pin-joined to the struts, and tests were made with 1, 3, and 7, uprights. The experiments showed an absence of proportionality between load and deflection when the spacing of the uprights exceeded the beam height. The deflection was found to decrease rapidly at first, then to approach a constant value, as the number of uprights increased.

(2) The plate was not fastened to the uprights, but the latter were attached to the struts by gusset plates. The tests were repeated with 1, 3, and 7 uprights. It was found that the deflections assumed a similar behavior, depending on the number of struts, but the values were much lower.

(3) The plate was fastened rigidly to the uprights and the latter were pin-joined to the struts. The principal result was that the deflections differed only slightly from those of case 2, but considerably from those of case 1.

(4) The plate was attached to the uprights and the latter were attached to the struts by gussets. The end deflections were about 10 per cent lower than for case 3. In contrast to case 3, the gusset plates raised the weight 12 per cent. The stresses in the struts, uprights, and in the plate, were measured and found to be within about 10 per cent of those calculated.

Comparison was made between the plate wall girder and a lattice beam. The latter had the same strut cross-sections as for the plate beam, and the proportions of the uprights and 45 deg. diagonals were such as to give the lattice beams the same weight as for the plate wall structure. The deflections of the lattice beams was about 15 per cent less than that of the plate wall beam, and the difference in strut tension in the latter amounted to less than 5 per cent of that in the lattice beam.

New Volumes for the Shelves

WOOD PRODUCTS IN THE AIRPLANE

WOOD IN AIRCRAFT CONSTRUCTION; *By G. W. Trayer; Published by Judd & Detweiler for the National Lumber Manufacturers Association, Washington, D. C.; $3.*

THOSE who are familiar with the many reports which Mr. Trayer has written during the past ten years will not be disappointed in this admirable book, which summarizes all the important work that the Forest Products Laboratory and certain other government agencies have done in connection with wood, plywood and glue with special reference to aircraft. The fundamentals of the structure, and identification of the important species by means of the structure, and briefly, though clearly, given, and well illustrated. Of general interest are the introductory chapter on the distribution of the species, with statistics on their annual production and estimates of the available supply, the chapter dealing with the strength, selection and suitability of woods, the one on seasoning, banding, gluing and protecting of lumber, and lastly, the discussion of the various types of decay and fungus growths. Mr. Trayer is practical in dealing with these subjects, and his suggestions and directions may be followed by those who handle and prepare lumber for final manufacture, in many cases, perhaps, with great improvement in the quality of their output.

In the chapter on the strength of woods, the author makes the excellent point that the principal causes for the variability of the strength properties of wood are known and can be eliminated by proper specifications and inspection. The effect of specific gravity, moisture content, duration of stress, locality of growth, rate of growth, and various defects are taken up, quantitatively for the most part, with simple charts. Spiral and cross grain are discussed, and the limiting size for various other defects. In addition to the standard table of strength values, a table showing these values in comparison with spruce is given.

The testing of glues and plywood is briefly explained and an interesting discussion given on the control of gluing conditions, including a table showing for the various species, the best amount of glue to spread, the best consistency, temperature, pressure, and limit of assembly time. In this chapter is an interesting note on the effectiveness of various coatings in moisture-proofing wood, with a tabulation of their relative effectiveness. This disposes summarily of the idea that plain spar varnish is much good for that purpose, and demonstrates the great effectiveness of aluminum powder when added to it or other vehicles.

The principles to be followed in the proper design of plywood for various purposes, tables of weights of veneer of the different species and thicknesses, and of strength of plywood of the same or mixed species, and notes on plywood for wing covering, comprise the chapter devoted to this subject.

The two remaining chapters of the book are the only ones devoted solely to aircraft design. In the chapter on aircraft parts the general design and manufacture of various types of beams, ribs and struts are taken up with notes on splicing and laminating and a discussion of the relative efficiency of various designs of ribs. Torsion tubes, spars, fuselage construction of the truss and monocoque types, wood float, and propeller construction are briefly touched on.

Most of the material in the book is available elsewhere, though for the most part not in as convenient form as it is presented by Mr. Trayer. However, the chapter dealing with advanced methods for calculating the strength of aircraft parts contains methods and information that are both new and highly interesting. To the reviewer this chapter appealed most strongly. It is of course of primary interest to structural engineers. Form factors for I and box beams are first explained. One misses the convenient chart used by Niles & Newell in determining them. To offset this a formula for form factor to be applied in the case of high rectangular beams, for which the allowable stress decreases as a function of the height, is presented. This is followed by formulas for computing deflections caused by shear stress for solid I and box beams. Allowable stresses at elastic limit and maximum load for members subjected to combined axial and bending loads are discussed with the aid of a chart. Next comes a short but fairly thorough treatment of the torsion problem with formulas for all normal types of sections. Somewhat allied to this is the important problem of the lateral twisting and buckling of deep beams. This is carefully investigated and many formulas given for various types of loading for rectangular and I beams. A stress-strain curve diagram from which the modulus of elasticity can be determined for stresses above the elastic limit, and for beams of different form factors is given. The wrinkling and twisting of columns is briefly discussed with formulas.

One of the best sections of the chapter deals with the calculation of the ultimate

strength of continuous beams. It is shown by theory and test that such a beam may be 30 to 40 per cent stronger than the bending moments given by the three-moment equation would indicate, due to the yielding of the highly stressed portions and the stressing up of the rest of the beam after the elastic limit is passed. The reviewer suggests that this unexpected increase in strength be made use of very cautiously. As a truss structure deflects, the panel points are thrown out of line and serious stresses are introduced. They may be computed by the three-moment equation if the relative deflections are known, but they seldom are. The chapter concludes with methods for the design of the webs of box spars and the bearing value of solid and hollow bolts on wood. The latter discussion and accompanying charts are the best the writer has seen.

In general, the book is well written and arranged, with good illustrations and cuts where they are desirable. It will form a distinct addition to any aeronautical engineer's library.—B. C. NEWELL [Glenn L. Martin Company].

THE MUNICIPALITY AND THE AIRPORT

AIRPORTS, THEIR LOCATION, ADMINISTRATION AND LEGAL BASIS; *prepared by the Harvard University School of City Planning; Harvard University Press; 190 pages; $3.50.*

UNDER the auspices of the Harvard School of City Planning a survey has been made of the American airport as a factor in the affairs of present day American cities. The report was prepared by Henry V. Hubbard (chairman of the school), Miller McClintock and Frank B. Williams, with the assistance of Paul Mahoney and Howard K. Menhinick. In order to provide a fresh basis for their investigation, a tour of 85 airports was made by Mr. Mahoney during two and a half months last summer. The data thus secured proves to be the most valuable element of the book.

Though it does not cover all types of landing fields, and though some figures and statements are open to question, the book undoubtedly offers as complete and informative a compilation of airport material as has been published in this country. Its value is enhanced by the fact that it is prepared by persons versed in the problems of municipalities and thus the book is treated from a particularly broad point of view.

Three phases of the subject are presented: The airport and the city plan, airport administration, and the law of airports. In the first division are considered the physical characteristics of suitable airport types, relation of airport to the city and region, and relation of the airports to the national transportation system.

In the second division ownership, administration, management and fiscal policy are discussed, and in the third there is offered extremely valuable information regarding national, federal and state jurisdiction over aviation; ownership of upper and lower air space, and rights in them; regulation of location; taxation; liability for negligence; insurance; neighboring property problems, and administration problems.

The authors do not attempt to discuss the vast quantity of information now accruing on such matters as design and materials. These are considered by them as "interior" problems. They concern themselves exclusively with the broader relation of the airport to the community as a whole and classify as exterior problems those questions involved therein.

With equal emphasis we are reminded that airports are receiving a very definite subsidy from the public through municipal ownership of airports and municipal management. We have taken this civic interest in the development of aviation bases for granted, but a comparison with civic policies toward terminals for other kinds of transportation reveals an unprecedented amount and kind of public support. This situation raises a number of fundamental questions which must be answered. Among them are the ability of cities to develop the type of management and financial operation needed to suit the peculiarities of the new terminal, and the determination of the city's true position in respect to airport ownership and operation in the light of the general community economics.

For a long time air law has been knocking at our doors for attention, and we have for the most part postponed attacking the problem on a broad front until circumstances force us to it. We have here a helpful discussion of the general problem as it affects airports from state and federal points of view.

Almost as interesting as the text is the appendix with its tables of statistics covering a variety of items.—CHARLES H. GALE, *Assistant editor of* AVIATION.

The Buyers' Log Book

MANIFOLDS

OXWELD Acetylene Co., 30 East 42nd Street, New York City, has introduced two small capacity manifolds to furnish small users of oxygen and acetylene with an economical means of gas distribution. They have been designed particularly for use by welding schools.

Both manifolds are of the wall type. The 6-cylinder oxygen manifold has the duplex feature so that three cylinders may be changed while the bank of three on the other side is maintaining the supply of oxygen. In the 4-cylinder acetylene manifold each cylinder lead has a valve in the header so that it is independent of the others. This makes it possible to use either one, two, three or four cylinders at the same time while a cylinder is being replaced. The 4-cylinder manifold is intended for installations where piped acetylene is required and where the installation of a generator would not be feasible.—AVIATION, *March, 1931.*

AIRCRAFT WATCH

A NEW watch, intended for use in airplanes, has just been added to the line of the Jaeger Watch Company, Inc., 304 East 45th Street, New York City. This watch is called the Chronoflite and comes equipped with a split second hand, indicating in fifths of a second, and a separate elapsed time dial with hour and minute hands. The movement is of the eleven jewel, 8 day type, and has a bimetallic balance. These watches are finished in black, with black dials; white figures and hands.—AVIATION, *March, 1931.*

PARACHUTE

A QUICK-ATTACHABLE pack and a harness with new features has been developed by the Triangle Parachute Company, Norwood, Ohio. It is designed for flyers whose duties require a freedom of movement such as gunners, photographers, co-pilots, or when cramped cabin or cockpit dimensions

Triangle parachute attached

render the use of an ordinary chute undesirable. The new pack should also have universal application in lighter than air work.

The parachute, which is of course, of the well-known triangular type looks when packed, a great deal like the once common lap pack. The distinguishing feature is that the halyards are brought to a single fitting which is permanently mounted on the bottom of the pack. The pack is kept in a rack in some convenient part of the aircraft. The harness worn by the flyer is quite similar to the ordinary type save that the two web members which would connect with the halyards are replaced by a fitting located over the position of an ordinary belt buckle. The two fittings are easily joined and lock in place with an almost foolproof certainty.—AVIATION, *March, 1931.*

DUPLEX REGULATOR

ANNOUNCEMENT has been made by Bastian-Blessing Company, Chicago, of the Rego Red Star two-stage regulator for welding and cutting. This instrument is in one compact unit and delivers to welding and cutting torches simultaneously. Both stages are governed by regulators having large size diaphragms of proper material. A constant neutral flame is thus maintained despite wide fluctuations in tank pressures, according to the manufacturer. Hexagonal adjusting screw handles permit delicate adjustment of gas flow and a lock-nut on the second stage adjusting screw holds the adjustment in spite of vibration of adjacent machinery.—AVIATION, *March, 1931.*

A NEW DRILL

ANNOUNCEMENT is made by Whitman & Barnes, Inc., Detroit, of Hercules Major drills designed to drill high manganese steel on a production basis. The new drill is made of a steel high in cobalt and tungsten. The web is heavy and the twist but two-thirds the length of regular taper shank drills, resulting in a rugged construction. The drill is pointed with a 68 deg. angle and the cutting lip has been blunted to strengthen the cutting edge.—AVIATION, *March, 1931.*

DEMAG HOIST

A HIGH speed hoist known as the Demag junior double acting hoist is now being manufactured by the Ambold Machine Tool Corporation of New York City. Equipped with a ¾ hp. electric motor, the hoist has a normal lifting capacity of 250 to 275 lb. and operates with two falls of wire rope, which is one continuous piece passing over a scored drum or sheave. The load is lifted at the rate of 85 f.p.m. and by adding a pulley block the load can be increased to 500 lb. raised at the rate of 42 f.p.m. —AVIATION, *March, 1931.*

Side Slips

BY ROBERT R. OSBORN

MR. B.E.M. Jr. of Windsor, Conn., finds a suggestion in the Hartford *Times* for cutting down overhead expenses on air transport lines,—until the Department of Commerce hears about it. The news item is describing the equipment being used on a new line which has just started operations on the East Coast:

"These were eight-place ships, powered by two Wright Whirlwind motors, and carry fourteen passengers, two pilots and a steward."

▶ANOTHER striking example of the present tendency to design all of the comforts of home into the modern airplane, is found in the description of a recent accident in Connecticut, clipped from the *Herald Tribune* of New York:

"Visibility was poor and ice formed on the wings of the plane. The ploughed field offered the only possible landing place, but sleet which covered the windshield made landing difficult and the ice-covered plane handled awkwardly. The propeller was snapped off, the wings broken and the undercarriage shattered. Miss Rhonie remained in the cockpit and was able to telephone to Roosevelt Field for a plane to call for her."

▶"A fifteen hundred foot parachute leap yesterday saved the life of Harold L. Laird, 6212 South Kenneth avenue, brother of E. M. Laird, president of the Laird Airplane Company. Mr. Laird, an expert pilot, was conducting an experimental flight with a two-passenger Sky Hawk. He reached an altitude of 6500 feet when the plane went into a backspin and could not be righted."

Clipped from the Chicago *Tribune* by Ted G., who is surprised that the pilot didn't know that backspin is needed only on the short approach shots to the putting green and suggests the advisability of shifting to the interlocking grip on the control stick.

▶MR. TED G. also sent in another clipping from the esteemed *Tribune* of Chicago describing the progress on blind flying equipment being developed by the General Electric Laboratory and the Sperry Company: "Details of the development were not available but it was learned that the co-ordinated device permits the pilot, once he has the plane in the air and pointed on its destination—say Chicago from New York—to be free to read a book, sit with the passengers, or go to sleep. The only thing he still has to watch is the motor."

These research scientists will probably be very surprised to know that there is already a device in use on the airlines which will perform these functions for the pilot. This device is known as the assistant pilot, second pilot, mechanic or steward depending on the nomenclature used on the various lines, and when operating perfectly allows the pilot plenty of time to check up on the stock market quotations in the *Times* or discuss philosophy with the passengers, or go to sleep. The only thing he still has to watch is his assistant.

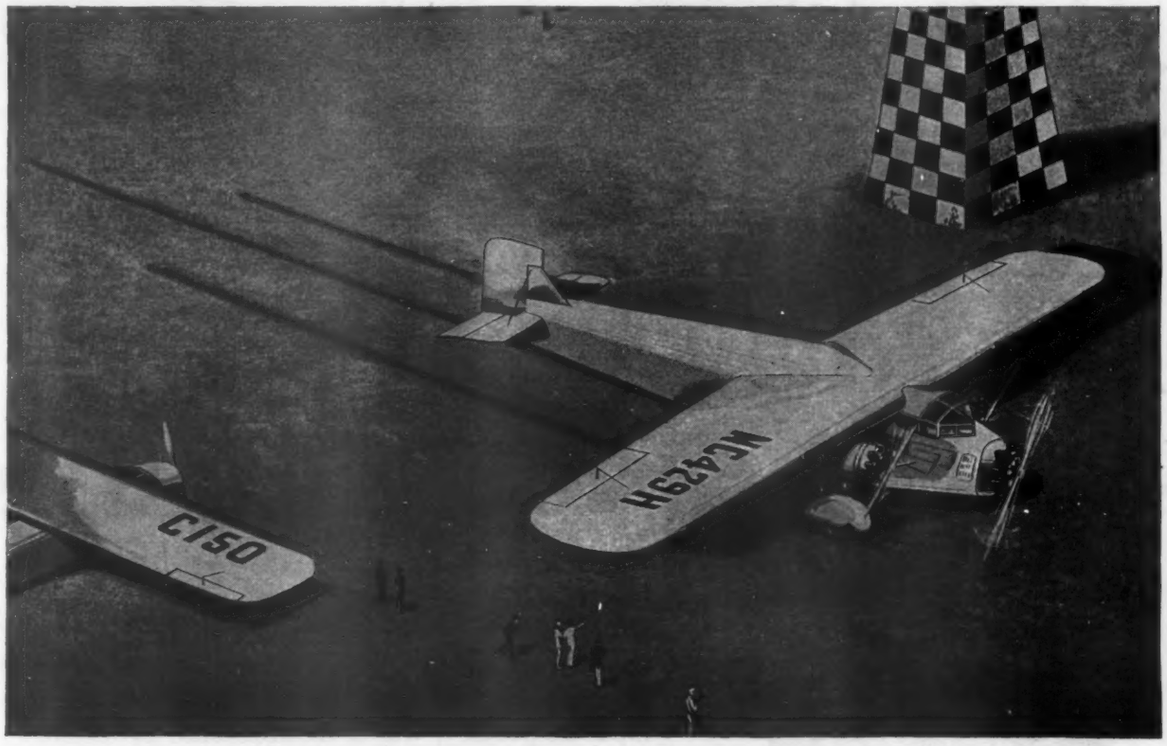
▶THE same article contains the following description of the new "sonic" altimeter, which leads us to make a suggestion: "Once directly over the field the sonic altimeter is put into play. The sonic altimeter utilizes the echo. It merely shoots a sound wave to the ground, catches it on the rebound and measures the time consumed in the round trip of the sound. As the plane nears the ground **** the sonic altimeter begins to whistle 'peep, peep.' The 'peeps' advise him tof his exact altitude and he hunts for a rift in the fog. If he cannot find one he noses down until the whistle and echo blend into one combined 'peep' and he knows he is at a height of only four or five feet. Then he can pull back on the stick and pancake to the ground with little danger to passengers and only minor injury to plane."

Our suggestion is that some other sound than "peep, peep" be used in this instrument, as that is already the accepted signal for valve gear in need of greasing, and we can't have our pilots pulling back on the stick whenever they hear a couple of peep-peeps out of the engine.

Another thought might be to have the instrument say "Uh oh! Aint that sumpin'?" when the "minor injuries to the plane" have developed to the point where the landing gear has gone by the board.

▶"THE plane is a single space biplane built entirely of tensile steel, designed particularly for day and night fighting at great heights." Item discovered in the *Foreign Aeronautical News* by C.F.McR. of California. He points out in the note accompanying the clipping that this new material should be investigated by our constructors, probably being much superior to the pig iron we are using in aircraft work. He does think, though, that the British plane described above should be redesigned so that it could fight at any time instead of just the hours of day or night, as one never knows when the enemy might strike.

WHEN STEERAGE WAY IS LOST



After landing, when rudder control is lost, your landing gear may make all the difference between safety and danger—especially on a busy field.

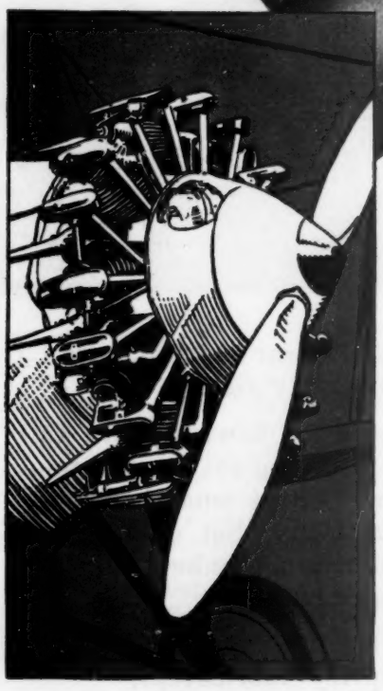
For full protection, you need Timken Bearing Equipped landing and tail wheels to keep your ship rolling straight and true after you set her down—wheels without weakness or wobble; wheels which permit smooth, even braking; wheels which possess the permanent stability that only the exclusive combination of Timken tapered construction, Timken positively aligned rolls and Timken-made steel can give.

Timken-equipped wheels have other important advantages, too. They prevent wear on axles; simplify lubrication; minimize the danger of losing wheels in the air; promote quicker take-off and save tires by preventing wheel-drag when landing.

They can be obtained on most planes as standard or special equipment. The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN *Tapered Roller* **BEARINGS**

SAVE THE ROCKER-ARMS



Effective, dependable lubrication is here most important. Until Texaco Marfak Grease came into general distribution, now available at the principal airports, it was a troublesome problem.

Texaco Marfak Grease is especially suited for the lubrication of rocker-arm assemblies and all enclosed grease-packed bearings.

It is peculiarly resistant to heat, clings to the bearing surfaces and retains its excellent lubricating qualities for long periods of service. It is strongly recommended, both by engine manufacturers and by aviators who have tried it.

Texaco Marfak Grease and the famous Texaco Airplane Oils and Texaco Aviation Gasoline are recognized everywhere for their high quality and uniformity. There is a Texaco Petroleum Product for every aviation need.

THE TEXAS COMPANY, 135 East 42nd Street, New York City

TEXACO

TEXACO AIRPLANE OILS
TEXACO AVIATION GASOLINE
TEXACO MARFAK GREASE

PERFECT BALANCE OF PLANES AND PRICE

BRINGS THE BUSINESS TO CURTISS-WRIGHT

See Curtiss-Wright's fleet for 1931 and you'll see seven new models so sleek in design, so ruggedly built, so simple to operate and to service that they speed Flying's progress faster than ever before. ● Here are the industry's outstanding craft . . . conceived by its keenest engineers, built by its first and foremost builder, backed by its only nation-wide Service Base chain, and distributed by its ablest Dealers. ● For into the development of these planes Curtiss-Wright has put vitally significant ideas and devices, evolved in years of experience in building aircraft for the entire field of flying. ● From the trim little *Junior* to the triumphant *Travel Air Sportsman* each of the new models will rule the sky-roads and the sales-rooms now and in time to come. ● For to the public, to pilots, to operators Curtiss-Wright is the best-known name. That's why the Curtiss-Wright Dealer Franchise is a document whose value you can depend on, an agreement that will help you grow!

CURTISS-WRIGHT
AIRPLANE COMPANY
ROBERTSON, MISSOURI
FACTORIES: ST. LOUIS, MO., WICHITA, KAN.

EASY TO BUY AND EASY TO FLY

CURTISS-WRIGHT "JUNIOR"

A real airplane completely equipped, fully licensed, that costs but $1490! **A 2-place, tandem-seated monoplane that takes off and lands "on a postage stamp"... from fair sized lawn or pasture lot... and it's so easy to fly that two men with no previous experience, soloed it in a single afternoon! ● The "Junior" needs no costly private flying field or hangar. It's so simply and sturdily constructed that you can park it outdoors if you wish, or run it under a shed. It asks no pampering, presents no service problem. For like your automobile it's always ready for you to hop in and go! ● Actually the "Junior" takes off lightly from the tightest of fields... cruises for three hours at 70 miles an hour... hits 80 when you want it to... and, due solely to its pusher type construction, offers *perfect visibility* as clear as from the front seat of a roadster... glides down and lands at 28 m.p.h.—stops in 150 feet —as easily as you stop your car! ● Developed by aviation's leading engineers, the "Junior" benefits by all Curtiss-Wright has learned in producing record-smashing sport and commercial craft. ● See your nearest Curtiss-Wright Dealer or write us for his name. Ask for a demonstration and learn why it's easy to buy, easy to fly, and easy to service the Curtiss-Wright "Junior"!**

ROBERTSON, MISSOURI ● FACTORIES: ST. LOUIS, MO. ● WICHITA, KAN.

STABILITY FOR SPORTSMEN

SIMPLICITY FOR STUDENTS

TRAVEL AIR
SPORT-TRAINER

Conceived and constructed by Aviation's outstanding engineering staff, this striking new Travel Air's stability for sport, and sturdiness for training is achieved by Curtiss-Wright's unequalled experience in the production of all types of planes. ● Ruggedly built, trimly refined, you'll like this smart little plane. It offers advances in stability, handling and servicing ease, which can be effected only when an organization builds for the whole field. ● Its clean-cut lines, its sleek streamlining, its speed in excess of 100 m.p.h. and cruising range of 500 miles, make it a craft of which you may be justly proud. ● Actually it's so stable in flight and so responsive to all controls that it's a real treat to fly it! Powered with the air-cooled Wright-Gipsy engine, with a full tread, shock-absorbing landing gear and brakes, this Travel Air is remarkably easy to control on the ground or in the air. ● In every detail it is designed to make flying and servicing by the owner as inexpensive as possible. Streamlining gives it sleek looks. That's why the Sport-Trainer will make a wide appeal to 1931 buyers!

CURTISS-WRIGHT
AIRPLANE COMPANY
ROBERTSON, MISSOURI

FACTORIES: ST. LOUIS, MO. WICHITA, KAN.

A COZY, SPEEDY CLOSED PLANE FOR TWO THAT'S EASY AND INEXPENSIVE TO FLY!

THE CURTISS-WRIGHT COUPE

Curtiss-Wright's new COUPE is a 2-place plane remarkable not only for its closed-car snugness and comfort, but for its simple inexpensive operation as well. ● For two can fly cross-country in this trim closed craft as cozily and cheaply as in a car! The interior is beautifully finished, with deep upholstery. Noise is reduced to a minimum. You can fly 15 smooth, sure miles to the gallon of gas . . . and the design of the plane is so simplified you can service it yourself. ● So easy to handle, too. Sensitive dual controls, side-by-side; exceptional visibility which is made possible only through this sleek low-wing design; dependable brakes and tail wheel for easy control on the ground—these are features you will experience with pleasure when you fly this new product of Curtiss-Wright skill in engineering. ● Then there is the added satisfaction of smooth, flexible power developed by the Wright-Gipsy engine, which speeds this smart little COUPE through the air at 110 m.p.h. and reduces long, hard trips to pleasant jaunts. ● But after all you must see and fly the COUPE for yourself to appreciate fully the marked achievement of Curtiss-Wright in this and other 1931 models. Ask your Curtiss-Wright dealer for a demonstration or write the factory and let us arrange one for you. Off the ground—and go!

CURTISS-WRIGHT AIRPLANE COMPANY

ROBERTSON, MISSOURI ● FACTORIES: ST. LOUIS, MO. ● WICHITA, KAN.

MAKES A MINUTE MEAN TWO MILES IN CUSHIONED EASE AND COMFORT!

THE TRAVEL AIR SPORTSMAN

The racy new 3-place TRAVEL AIR *Sportsman* is a rugged, 2-miles-a-minute performer which rides with the ease and comfort of a touring car! ● Smoothly it glides down the runway... leaps skyward within 150 yards... climbs 750 feet a minute... levels off... strikes 120 m.p.h. if you wish... and with the endurance of its record-holding Challenger engine cruises easily over 600 miles in six hours! ● The sturdy *Sportsman* is an able sky rider and a cozy carrier for three because Curtiss-Wright designers, knowing what private pilots prefer, have put into this craft the progressive devices taken from their long experience in building many types of planes. ● It floats in and lands at 48 m.p.h. Special TRAVEL AIR shock absorbers, and split-axle undercarriage eliminate the shock of careless landings on rough fields. Internal expanding brakes assure ground control. The entire fuselage structure is made of strong alloy steel. Wide wings give you easy, sure, stable control. Convenience of seats, controls, instruments, and fittings—even to strap-cradle for extra luggage—make the *Sportsman* as comfortable as a car. ● Here is *your* plane, your *personal* craft. See your Curtiss-Wright dealer for a demonstration and you'll want to fly the *Sportsman* away!

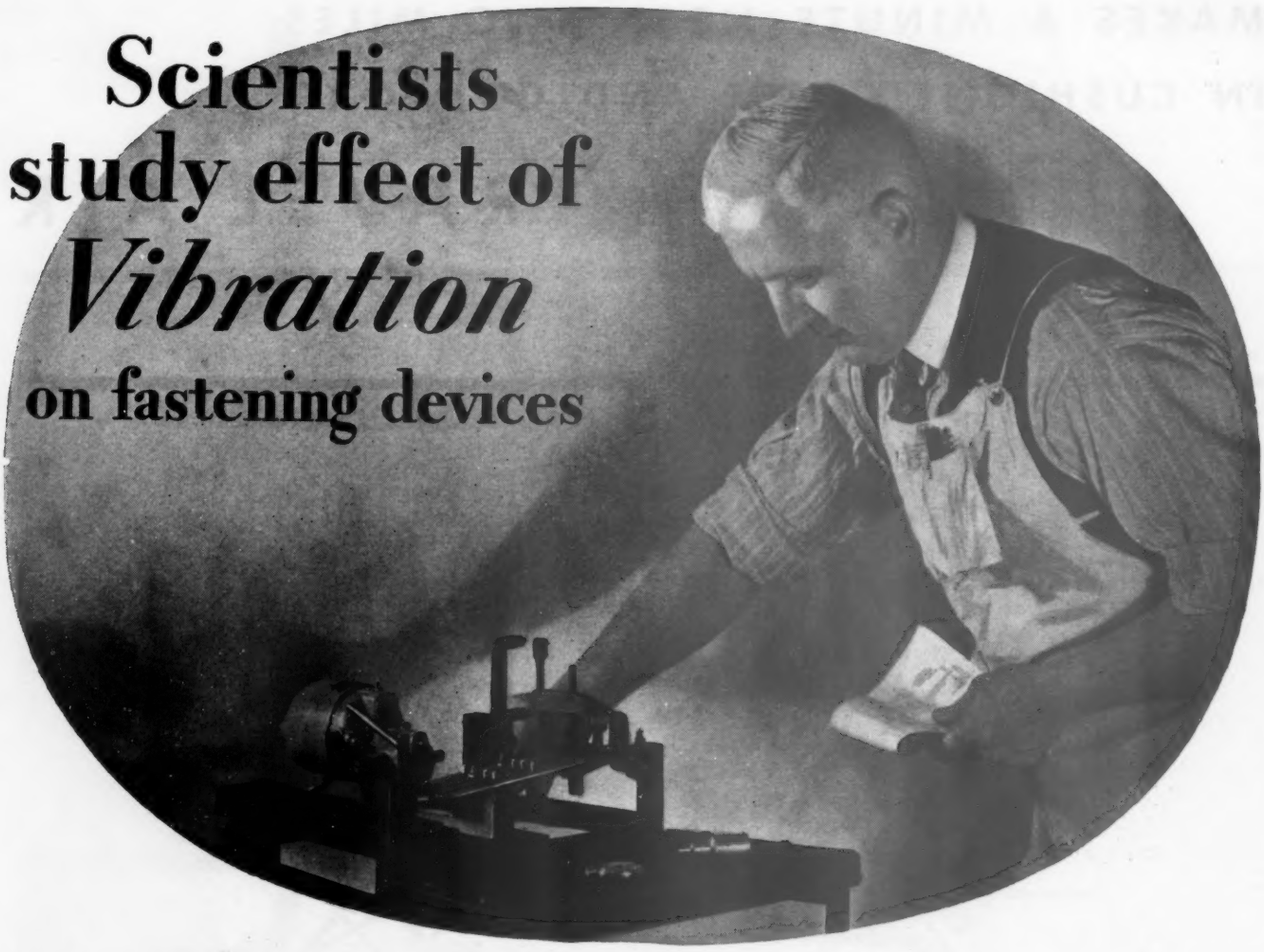
CURTISS-WRIGHT

AIRPLANE COMPANY

ROBERTSON, MISSOURI

FACTORIES: ST. LOUIS, MO. WICHITA, KANSAS

Scientists study effect of *Vibration* on fastening devices



"It is evident that fastenings made with Self-tapping Screws will resist vibration much better than machine screws" say authorities of the COLLEGE OF ENGINEERING OF N. Y. U. *after tests.*

FOR weeks scientists of the College of Engineering of New York University studied the holding power of fastening devices. By unbiased tests they were to determine whether Self-tapping Screws, noted for economy in assembly work, have greater or less holding power than the fastening devices they usually replace.

Particular attention was given to the effect of vibration, for it is the chief cause of fastening failure. The specially constructed vibrating machine, shown above, was run more than a hundred hours under close observation. Four test specimens were subjected to the vibration—each specimen containing two sizes of Self-tapping Screws, and an equal number of the equivalent sizes of machine screws, the most common alternative means of fastening.

Early in the test the majority of the fastenings made with machine screws failed. *Yet not a single Self-tapping Screw loosened.* The report of the authorities conducting the test states:—"It is evident that Parker-Kalon Hardened Self-tapping Screws will resist vibration much better than the conventional machine screw".

Detailed information developed from the extensive tests made at N. Y. U. of the comparative strength of fastening devices under stresses of vibration, tension and shear will be found in the booklet offered here. The coupon brings it, free; with another helpful booklet showing the large savings gained on metal assemblies through the use of these unique Screws that eliminate tapping, fumbling with bolts and nuts and other fastening difficulties.

PARKER-KALON CORPORATION
Dept. M., 192-200 Varick Street, New York, N. Y.

Send me free booklets on the Security and Economy of assemblies made with Self-tapping Screws.

Name and Co.----------

Address----------

PARKER-KALON
HARDENED
Self-tapping Screws
PAT. IN U.S. AND FOREIGN COUNTRIES

"Distributors Serve Industry Economically"

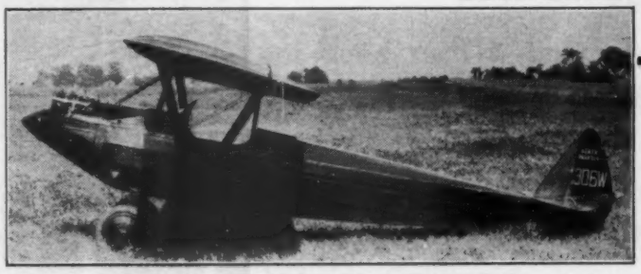
At last!

—LARGE PLANE SAFETY . . .
—LARGE PLANE PERFORMANCE
—LARGE PLANE ENJOYMENT . . .

IN A PLANE *YOU* CAN AFFORD—

The HEATH PARASOL $975 COMPLETE

(Special equipment free for a limited time only)



Flown exactly like the largest planes—the new Heath Parasol differs from more expensive ships only in size. Its smaller construction affords convenience and flying ease unmatched in all of aviation history!

"YOU fly it *just* like the bigger planes. It's as stable as a transport ship. And once you're at the stick —you're as proud as the owner of a $10,000 plane!"

That's the way *one* enthusiastic owner describes the new Heath Parasol. For not even the largest planes are constructed with more care and precision. Into every Heath part is built 22 years of light plane experience. And as a result—large plane safety and performance are yours for the first time *at a price you can afford.*

To fly it is to want it!

Unless you have flown the new Heath Parasol yourself—you can't possibly appreciate its value. Take it up to 18,000 feet. Fly 400 miles cross-country without a stop! Race along at an 85 mile per hour clip. And put it through all the stunts you've done in the larger planes. Then you'll begin to understand its tremendous popularity.

Observe its full vision above and below—and even dead ahead beneath you. Note its unparalleled low flying cost—actually *less than one cent a mile* including gas, oil, storage, etc. And consider that it requires no airport or hanger as it lands on any field or even a highway. And with wings mounted on the sides it can be stored in a country barn or city garage!

THESE OWNERS
once were doubtful—now read what they say—

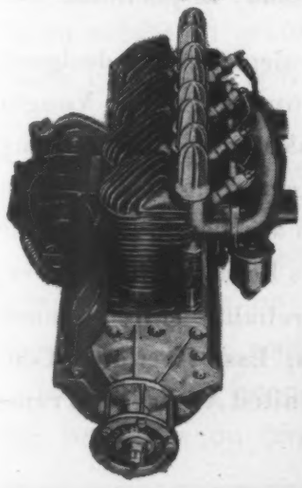
"—my Parasol outperforms any ship flying out of our airport—4900 feet above sea level."
"—anyone who has ever soloed can fly a Parasol with complete safety."
"—the ship handles well. I took it to 9000 feet in my first flight and find it great for building hours."
"—the Parasol has twice the beauty, workmanship and ability that I expected."
"—the Heath Parasol is the finest sport plane and the most practical ship I've ever seen for twice the money."

(excerpts taken from letters on file at Heath factory in Chicago.)

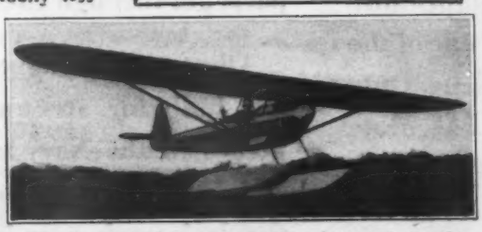
Act now and get extra equipment free!

Don't sit back again this summer and wish you too could fly! Investigate the new Heath Parasol now. By buying now—you get such important accessories as air wheels, motor starter, brakes, and metal propeller *without a penny extra charge.* They will add immeasurably to your enjoyment of the plane.

Don't delay another day. 10 cents in stamps or coin brings our large illustrated booklet. Mail the coupon below today.



The new Heath B4 Engine, first place winner at the 1930 National Air Races, is exclusively an aircraft motor—and is standard equipment with all Heath flyaway planes.



Sea plane floats can be quickly substituted for the regular landing gear. This actual photograph shows that the Sea-Plane Parasol loses none of the stability for which the land plane is famous.

A few Heath Parasols lined up at the Heath Airport. Chicago. Hundreds of these remarkable little planes are in use today—some in such distant countries as India and Peru!

WE INVITE DEALERS!

Sell the Heath Parasol—and enjoy the greatest profit opportunities in the aviation industry today. No other plane has so wide a market. No other plane appeals to so *many* types of fliers. The purchase of only *one* Parasol at the regular price of $975 entitles you to be the Heath representative in your territory. Write today for our attractive discount plans. Mail the coupon below.

Remember—every man who flies is a prospective Heath owner!

HEATH AIRCRAFT CORP.

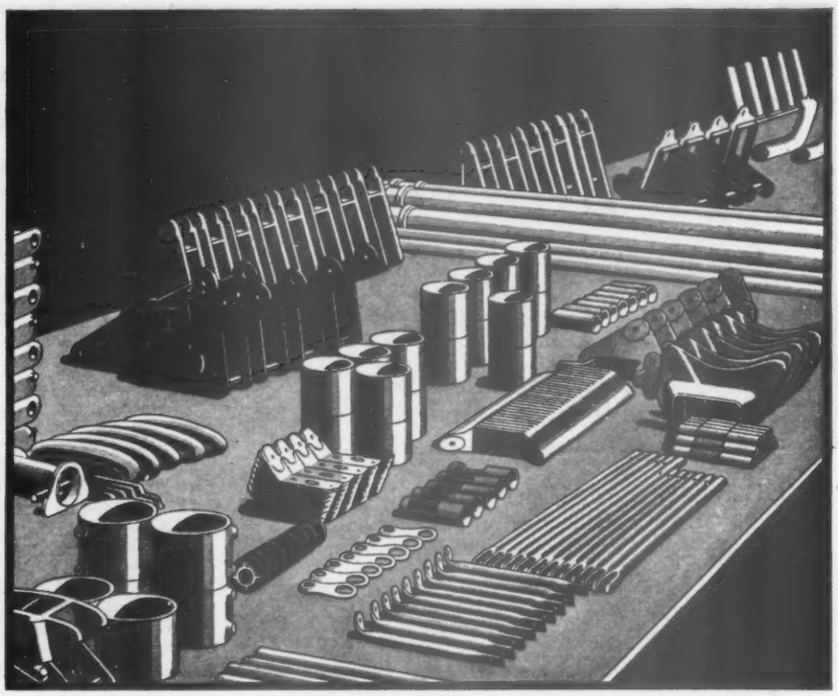
AIRCRAFT CORP., CHICAGO

HEATH AIRCRAFT CORP., Dept. V331,
1721-9 Sedgwick St., Chicago, Ill.

Without obligation please send me your interesting illustrated booklet on the new Heath Parasol. I enclose 10 cents for postage.

☐ I am interested in the Heath Parasol for my own use.
☐ I am also interested in selling the Heath Parasol in my territory.

Name .....
Address .....
City ..... State .....

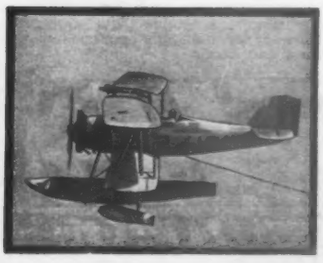


BUILDING STAMINA INTO CHANCE VOUGHT AIRPLANES

Until a seaplane has to be set down in a rough sea, a pontoon strut fitting is just one of a thousand details. But at the instant of landing, that fitting is either a perfect part or a real menace. There can be no compromise between the two. And so with every one of the hundreds of parts in a reliable airplane. Only by careful selection of materials, by accurate control in fabrication, thorough and frequent inspection . . . all backed by proper design . . . . can such perfection be attained. And every part in a Chance Vought plane is made and tested by that formula.

In the sunlit Vought plant, presses punch out the parts from which built-up fittings are made. Vought-trained mechanics do the welding and brazing. And Vought-trained inspectors watch the work. At every step, each part is subjected to careful check. None but perfect parts get through the many inspections.

All parts in Vought airplanes are designed and built for strenuous service. Vought planes in the Navy take catapult launching and deck landing into arresting gear as all in the day's work, year in and year out. And for sport and business, it's hard to find a faster, sturdier and more reliable ship. Chance Vought Corporation, East Hartford, Connecticut. Division of United Aircraft & Transport Corporation.



CHANCE VOUGHT CORPORATION

QUICK STOPS MAY SAVE YOUR SHIP!

Every pilot knows he can't always pick his landing conditions. Mud, sand, plowed ground, or a 2 by 4 landing field can look mighty good when gas is low and the ceiling is lower. And they look a lot better when you know you will land on Airwheels with the new roller-bearing brakes.

These big, soft rolling pillows bring you down safely on ground that would put a plane on its nose if it had any other wheel and tire equipment. They make cross wind and down wind landings with perfect control.

Then the new Airwheel brake goes into action and the ship comes to a sure, smooth STOP.

There's never been anything like this brake on an airplane before. It has *power—smoothness—certain release.*

With this new Goodyear brake you can either slide the wheels or bring up the tail, depending on the landing surface, *and still keep complete control.* Its release is as sure as its braking action — its power will hold the plane at a standstill with full throttle — and *stop it again* when you let it roll.

You may not need such a brake for ordinary landings — but when you need it you need it bad.

For full engineering data, write or wire Aeronautics Department, Goodyear, Akron, Ohio, or Los Angeles, California.

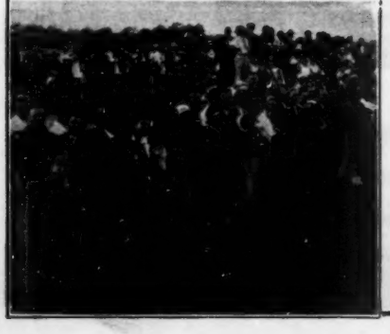
WHEN YOU BUY A NEW SHIP SPECIFY GOODYEAR AIRWHEELS

GOODYEAR

EVERYTHING IN RUBBER FOR THE AIRPLANE

ONLY A CLEAR FIELD IS A SAFE FIELD

An Anchor Fence doing crowd-control duty during the landing of Coste's plane.



A two-hundred-acre field ceases to be two hundred acres when airport visitors and their automobiles crowd the field. An airport is supposed to be devoted exclusively to flying. Planes should not have to fight with crowds and parked automobiles to land and take-off.

The airport operator can attract planes and reduce the risk of accident by giving the pilot every available foot of area the field affords.

Only a clear field is a safe field. Keep your field "clear" by barring crowds from the flying area with an Anchor Fence.

The local Anchor representative will be glad to explain our complete Airport Fencing Service. Just phone or write him to call. Or, send for a catalog.

ANCHOR POST FENCE COMPANY
Eastern Ave. and Kane St., Baltimore, Md.

Albany Boston Buffalo Charlotte Chicago Cleveland Detroit Hartford Houston Los Angeles Mineola, L.I. New York Philadelphia Pittsburgh St. Louis San Francisco Shreveport

Representatives in all principal cities. Consult your local classified directory.

ANCHOR FENCES

Easier landing–
easier ground maneuvers

BENDIX

WHEELS AND BRAKES

They make small fields larger; they bring new efficiency, ease, and safety to all ground operations.

Thus have Bendix Wheels and Brakes for aircraft contributed immeasurably to practical aeronautics.

Alexander Industries, Inc.
Bellanca Aircraft Corporation
Boeing Aircraft Company
Buhl Aircraft Company
Cessna Aircraft Company
Consolidated Aircraft Corp.
Curtiss Aeroplane & Motor Company
Curtiss-Wright Airplane Company
Detroit Aircraft Corporation
Douglas Aircraft Company, Incorporated
Fairchild Airplane Mfg. Co.
Fokker Aircraft Company
Keystone Aircraft Corporation
E. M. Laird Airplane Company
The Glenn L. Martin Company
Northrup Aircraft Company
Pitcairn Aircraft, Incorporated
Spartan Aircraft Corporation
Stearman Aircraft Corp.
Stinson Aircraft Corporation
Thomas-Morse Aircraft Corporation
Verville Aircraft Company
Chance Vought Corporation
U. S. Air Corps (for all ships)
U. S. Navy (Bureau of Aeronautics) etc.

BENDIX BRAKE COMPANY
SOUTH BEND, INDIANA
(Division of Bendix Aviation Corporation)

BENDIX 4 BRAKES

FOR SAFETY

FULLY PROTECTED BY PATENTS AND APPLICATIONS IN U. S. AND ABROAD

Air Mail Saves Time

Fly more — Repair less

USE

PENNZOIL*

Costs less per flying hour

Planes lubricated with ordinary oils require overhauling every 150 to 250 hours. Planes lubricated with Pennzoil Aircraft Oils are regularly and safely flown 300 to 400 hours without overhauling.

Pennzoil cuts down repair time and cost, increases the flying time you get out of your plane.

This is one reason why America's greatest passenger lines and good operators everywhere use it.

Another reason is that it lasts twice as long as ordinary oils—it gives you many more hours of flying with every filling.

Pennzoil is made from 100% Pennsylvania crude and nothing else. It differs from all other Pennsylvania oils because of the famous Pennzoil process which uses only the heart of the crude—the fraction richest in lubricating efficiency. Sold at most airports from coast to coast.

THE PENNZOIL COMPANY. Executive Offices and Refinery: Oil City, Pa.
Division Offices: New York, Chicago, Los Angeles
British-American Oil Co., Ltd., Sole Distributors in Ontario and Quebec, Canada

It isn't enough to ask for "Pennsylvania oil"
—to be sure of lowest cost per flying hour, say "PENNZOIL"

35¢ a quart

[Slightly higher in Canada]

100% PURE PENNSYLVANIA
PENNZOIL
SAFE LUBRICATION

Hear Pennzoil Pete and Andy Sannella's All Star Orchestra over WJZ and other N. B. C. stations Sunday evenings 10:15 Eastern Standard Time.

PERMIT NO. 2—PENNSYLVANIA GRADE CRUDE OIL ASS'N

This seal is more than a pledge of 100% Pure Pennsylvania. It is our guarantee to you of highest quality finished Motor Oil.

STANDARD THE SIOUX WORLD OVER

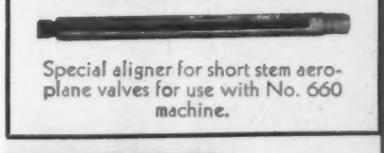
VALVE FACE GRINDING MACHINE

Precision Work on Valve Refacing

and other valve jobs, is done easier and quicker on the Sioux Valve Face Grinding Machine. It is so accurate, dependable and sturdy because it has these exclusive Sioux features:—

1. **Sioux Roller Chucking System** grips valve stem firmly above worn surface and holds it perfectly centered. Self-aligning, adjustable, positive, accurate.
2. **Automatic Lubrication**—through oil-filtering felt wicks. Keeps out grit and dirt.
3. **Smooth, positive operation,** with fewer parts, through use of SKF self-aligning ball-bearings.
4. **Simple, positive fool-proof method** of engaging and disengaging drive shaft by means of a cam shaft.

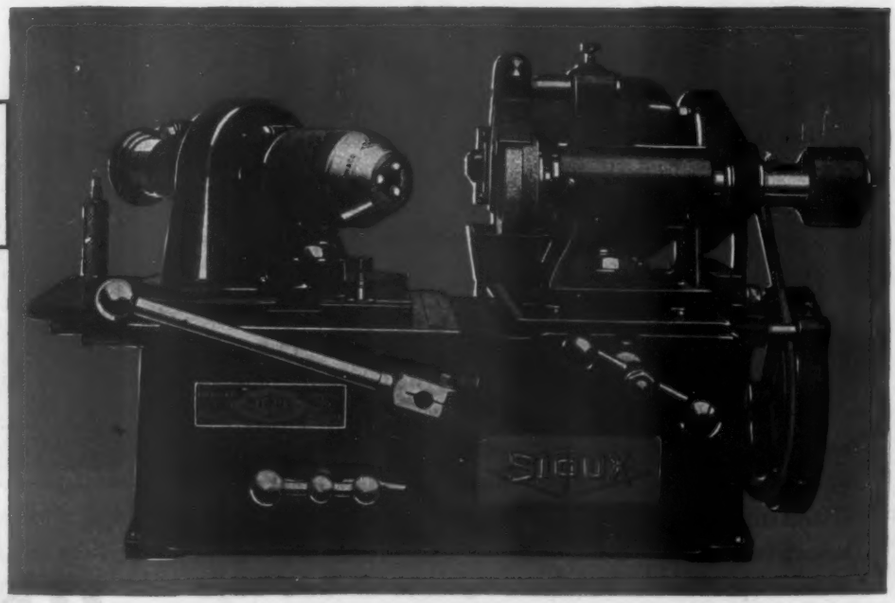
Only in the "Sioux" can you get these features and the famous Sioux guarantee. Investigate before you buy.



Special aligner for short stem aeroplane valves for use with No. 660 machine.

Grinding Valve

Sharpening aeroplane reamer with No. 898 attachment on No. 660 machine.



No. 660 for aeroplane valves of any angle. Handles valve stems of 5/16 in. to 13/16 in. diameter. Complete with ¼ H.P. A. C. motor, extra grinding wheel for large, hard valves, wrenches, etc.

Net $187.50

Your Jobber Sells Them

ALBERTSON & CO. INC.
SIOUX CITY, IOWA. U.S.A.

FAMOUS FLIGHTS WITH THOMPSON VALVES

WHEN THE "QUESTION MARK" SET THE FIRST SIGNIFICANT REFUELING RECORD

(This advertisement is one of a series recalling historic airplane flights in which Thompson Valves were used.)

Refueling an airplane in flight was not an unprecedented feat in 1929. But its use to accomplish *the first refueling endurance flight in history* remained for Maj. Carl Spatz, Capt. Ira Eaker, Lieut. Elwood R. Quesada, Lieut. Harry A. Halverson and Staff Sergt. Roy Hooe, of the U. S. Army Air Corps.

Taking off in the tri-motored monoplane, "Question Mark," on New Year's morning, 1929, they flew for more than 150 continuous hours. All former heavier-than-air sustained flight records, including those of dirigibles, were exceeded by many hours.

It is significant that in this first aero motor "breakdown" test under actual flying conditions, just as in the first outstanding full-throttle block tests, Thompson Valves *stood up*. The 54 Thompson Valves in the three Wright Whirlwind motors of the "Question Mark" survived the terrific grind in condition capable of many more hours of flight.

This and many other famous demonstrations have influenced the adoption of Thompson Valves for America's finest airplane engines.

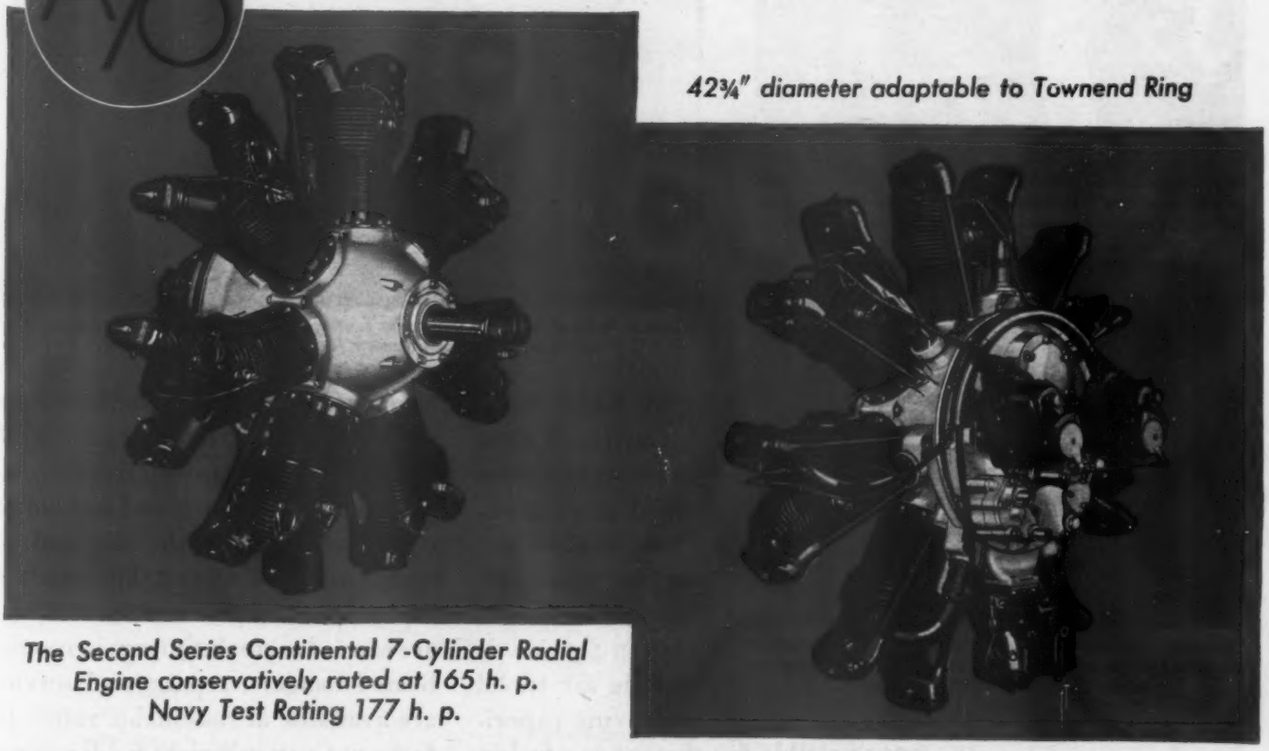
Thompson Valves

THOMPSON PRODUCTS, INCORPORATED
General Offices: Cleveland, Ohio, U. S. A.
Factories: CLEVELAND and DETROIT

THE *Lightest*

165 HP AIRCRAFT ENGINE ON THE MARKET

A70



42¾" diameter adaptable to Townend Ring

The Second Series Continental 7-Cylinder Radial Engine conservatively rated at 165 h. p. Navy Test Rating 177 h. p.

The Continental A-70 Second Series aircraft engine, ready for flight, complete with magnetos, carburetor, starter and pump mountings, weighs only 390 pounds. With exhaust ring, air heater and cleaner—415 pounds. ¶ Materially lighter than any other engine in this power range, the A-70 Second Series incorporates all the sturdy, rugged qualities that characterized the original A-70 and established its reputation for smoothness and reliability. ¶ These engines, after 200 hour full throttle test runs, required absolutely no replacements—proving conclusively their unusual stamina—their ability to stand up under the rough treatment of commercial service.

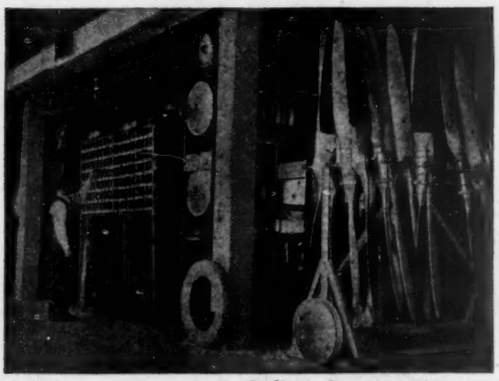
CONTINENTAL AIRCRAFT ENGINE COMPANY
General Office and Factory, Detroit, Michigan

Continental Engines

This time
CURTISS-WRIGHT

Stanavo Aviation Engine Oil has been selected by the Curtiss-

Mechanics who know motors from A to Z, and well-lighted, completely equipped shops at every hangar.



Aviation accessories, including Stanavo Aviation Engine Oil, to meet every need, are to be found in every Curtiss-Wright stock room.

Modern, heated hangars are to be found at all Curtiss-Wright fields. They are equipped with every facility for airplane users.

FOR MANY YEARS Curtiss-Wright has served the world of aviation. Pioneers since the earliest days, today Curtiss-Wright Flying Service is making air travel and flying experience possible for thousands of alert Americans.

From coast to coast it is known for every phase of commercial flying—student training, aerial mapping, photography and surveying, sightseeing, transportation, sales and service.

Its service for permanent storage and transient flyers—the most complete and practical of its kind in this country—is operated from thirty permanent bases. These bases are modern in every respect. Large, well-drained fields—hard surfaces—complete weather reports and up-to-date equipment are at the disposal of transient flyers. Over 4,000 standard replacement parts and accessories are carried in stock. Storage in roomy, heated hangars, repairs and service are available at reasonable rates. In fact—at Curtiss-Wright fields—every effort is made to add to the flyers' comfort and to make flying more attractive to the public.

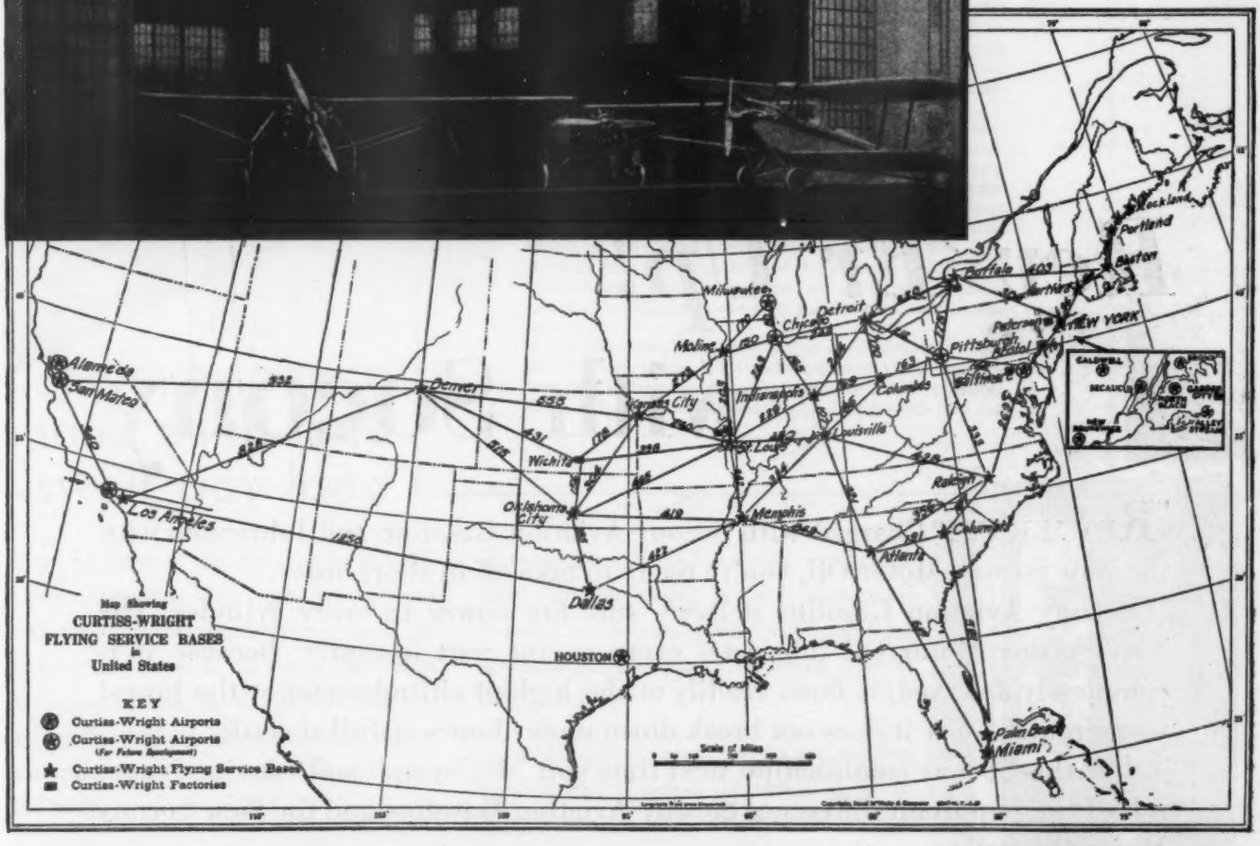
At fields of this type you would expect to find Stanavo—and *you do.* As is the case with many others of the country's leading air transport companies, Stanavo Aviation Engine Oil is in use and available for all flyers at each of the fields of the Curtiss-Wright Flying Service.

Visit the Stanavo Exhibit at the National Aircraft Show.

goes STANAVO

Wright Flying Service—the "World's Oldest Flying Organization"

Curtiss-Wright fields and flying bases are conveniently located from coast to coast.



STANAVO

AVIATION ENGINE OIL

One Brand—STANAVO. One Quality—the Highest—Throughout the World

STANAVO SPECIFICATION BOARD, Inc.

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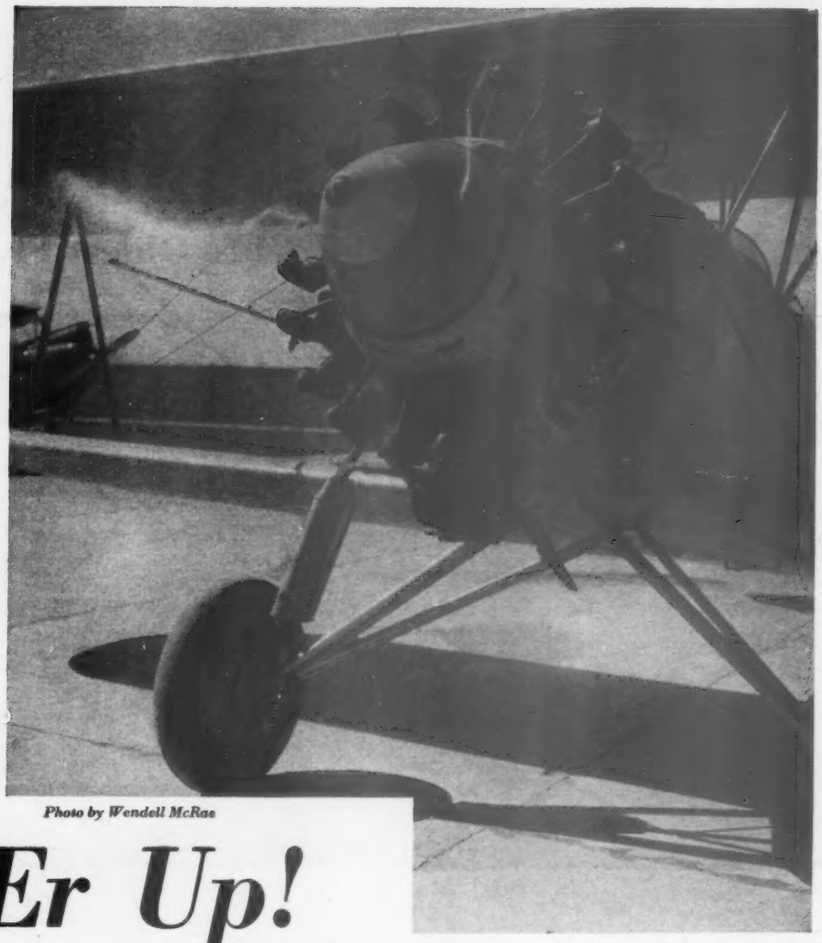


Photo by Wendell McRae

Rev 'Er Up! with Socony

"REV 'ER UP!" Charged with Socony Aviation Gasoline and lubricated with the New Socony Motor Oil, you're ready to take off in short order.

Socony Aviation Gasoline delivers sure-fire power to every cylinder. The New Socony Motor Oil lubricates every engine part instantly. Because it is completely dewaxed, it flows readily at the highest altitudes and at the lowest temperatures. Yet it does not break down under hours at full throttle.

Use this Socony combination next time you "rev 'er up" and convince yourself of the important difference Socony Aviation Gasoline and the New Socony Motor Oil make.

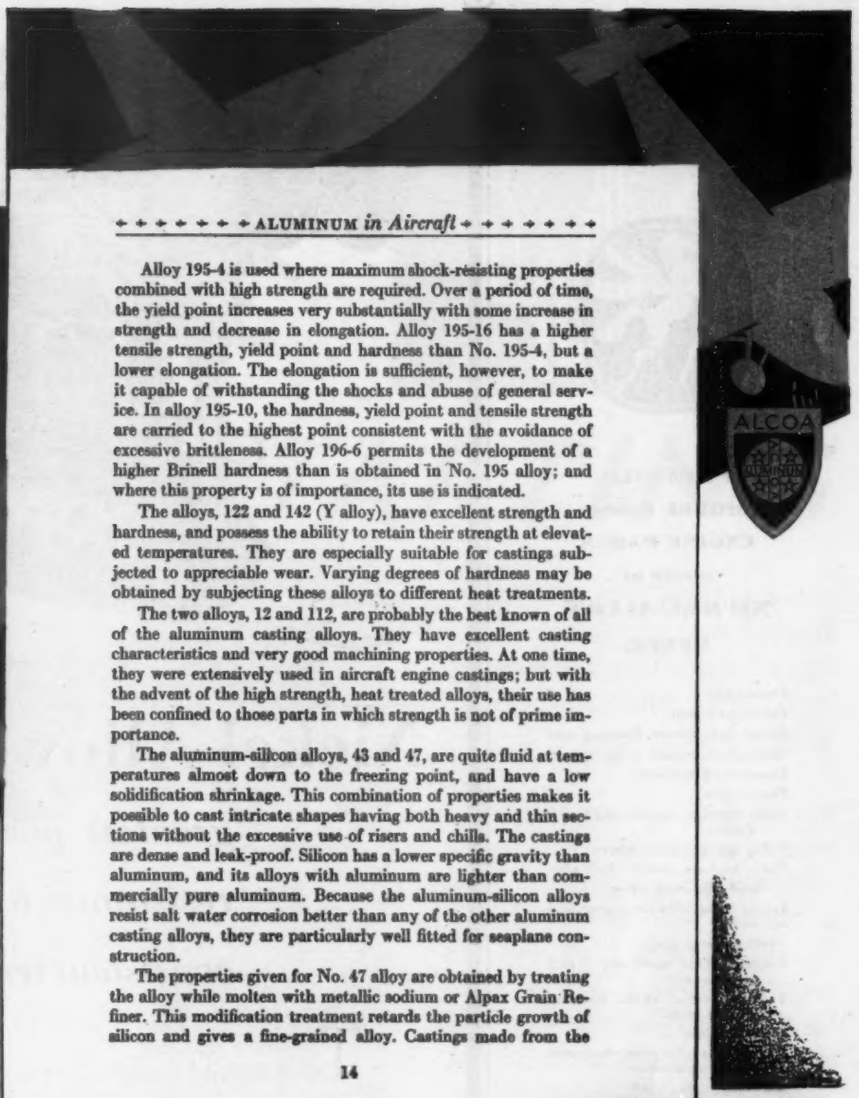
SOCONY

Socony Aviation Gasoline **New Socony Motor Oil**

STANDARD OIL COMPANY OF NEW YORK

Read this page FREE

then send 50 cents for the other 159 pages . . .



+ + + + + + + ALUMINUM *in Aircraft* + + + + + + +

Alloy 195-4 is used where maximum shock-resisting properties combined with high strength are required. Over a period of time, the yield point increases very substantially with some increase in strength and decrease in elongation. Alloy 195-16 has a higher tensile strength, yield point and hardness than No. 195-4, but a lower elongation. The elongation is sufficient, however, to make it capable of withstanding the shocks and abuse of general service. In alloy 195-10, the hardness, yield point and tensile strength are carried to the highest point consistent with the avoidance of excessive brittleness. Alloy 196-6 permits the development of a higher Brinell hardness than is obtained in No. 195 alloy; and where this property is of importance, its use is indicated.

The alloys, 122 and 142 (Y alloy), have excellent strength and hardness, and possess the ability to retain their strength at elevated temperatures. They are especially suitable for castings subjected to appreciable wear. Varying degrees of hardness may be obtained by subjecting these alloys to different heat treatments.

The two alloys, 12 and 112, are probably the best known of all of the aluminum casting alloys. They have excellent casting characteristics and very good machining properties. At one time, they were extensively used in aircraft engine castings; but with the advent of the high strength, heat treated alloys, their use has been confined to those parts in which strength is not of prime importance.

The aluminum-silicon alloys, 43 and 47, are quite fluid at temperatures almost down to the freezing point, and have a low solidification shrinkage. This combination of properties makes it possible to cast intricate shapes having both heavy and thin sections without the excessive use of risers and chills. The castings are dense and leak-proof. Silicon has a lower specific gravity than aluminum, and its alloys with aluminum are lighter than commercially pure aluminum. Because the aluminum-silicon alloys resist salt water corrosion better than any of the other aluminum casting alloys, they are particularly well fitted for seaplane construction.

The properties given for No. 47 alloy are obtained by treating the alloy while molten with metallic sodium or Alpax Grain Refiner. This modification treatment retards the particle growth of silicon and gives a fine-grained alloy. Castings made from the

14

This book tells you how to shrink dead-load —swell pay-load

After 14 years of day by day work with Alcoa Aluminum—14 years of working with the U. S. Bureau of Standards, U. S. Army Air Corps, U. S. Navy Bureau of Aeronautics, The Naval Aircraft Factory, and with airplane manufacturers, operators, pilots and mechanics—we offer you this book.

Every one of its pages is devoted to recording *facts* about where Alcoa Aluminum can be best employed in aircraft: the mechanical, physical and chemical properties of Alcoa Aluminum and its various strong alloys: instructions for cold-working, heat-treating, annealing, and joining aluminum: pointers on necessary shop equipment for maintenance and repair of Alcoa Aluminum parts.

44 tables and 60 photographs are used to explain and illustrate pertinent data. In fact, here is a book which tells how to shrink dead-load—swell pay-load. And it costs only 50 cents. U. S. Postage Stamps accepted. Use the coupon. ALUMINUM COMPANY *of* AMERICA; 2482 Oliver Building, PITTSBURGH, PENNA.

HERE'S A COUPON FOR YOUR CONVENIENCE

▲ ▲ USE IT ▲ ▲

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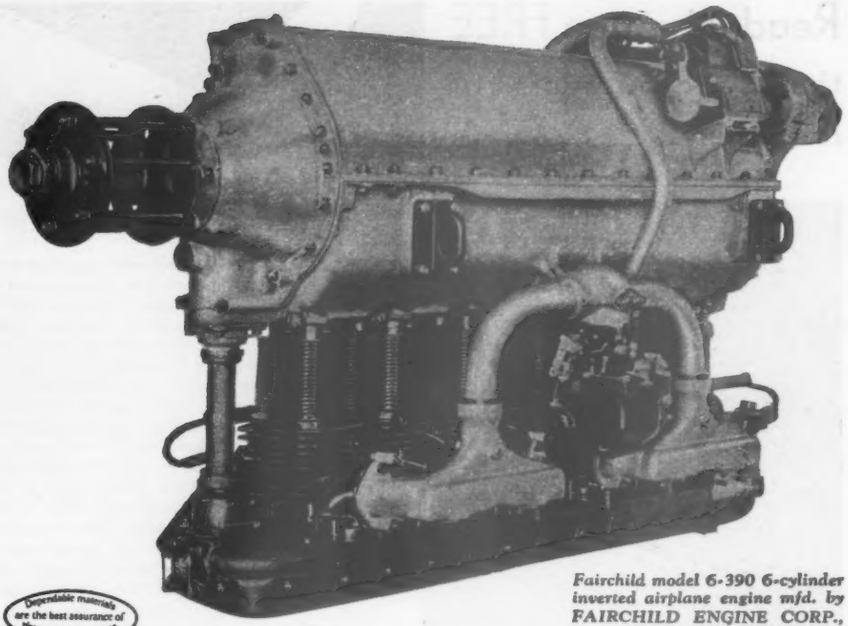
ALCOA ALUMINUM

The one metal that flies best



Fairchild model 6-390 6-cylinder inverted airplane engine mfd. by FAIRCHILD ENGINE CORP., *Farmingdale, N. Y.*

Dependable materials are the best assurance of dependable performance

FAIRCHILD MODEL 6-390 ENGINE PARTS *made of* NICKEL ALLOY STEEL

- Crankshaft
- Crankshaft gear
- Crankshaft thrust bearing nut
- Crankshaft center plug spacer
- Connecting rod bolts
- Piston pins
- Valve springs—upper and lower washers
- Valve spring lock washers
- Valve rockers, rocker hub pins and adjusting screw
- Lower front idler drive gear and shaft
- Vertical drive shaft
- Vertical drive shaft upper and lower gears
- Vertical drive shaft housing packing nut
- Camshaft gear
- Upper front idler gear, shaft, and retaining washer
- Accessory drive shaft
- Accessory drive shaft front and rear gears
- Accessory drive shaft thrust plug
- Rear idler gear
- Magneto drive gears
- Magneto coupling gears
- Magneto control rods
- Oil pump gears and shafts
- Pressure oil relief valve seat and cap
- Fuel pump gears
- Tachometer gears and shafts
- Tachometer and fuel pump drive adapter
- Tachometer gear insert
- Propeller hub nuts, bolts, key, and dowel
- Starter driving jaw
- Crankcase main bearing studs
- Cowl supports
- Drain pipe packing nut

AUXILIARY PARTS

Studs — Keys
Bolts — Nuts — Cup plugs
Screws — Shouldered plug
"Y-Alloy" cylinder head castings

Nickel Alloy Steels . . . have

"greatest possible strength and resistance to fatigue and wear consistent with minimum weight"

THE Fairchild Engine Corporation states:

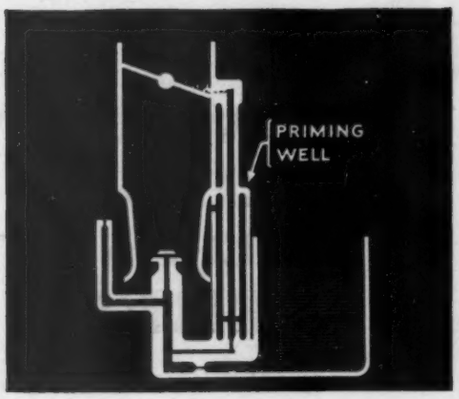
"Our reason for using Nickel Alloy Steels for the parts given on the attached list is because the particular steels selected for each part must have the greatest possible strength and resistance to fatigue and wear consistent with the minimum possible weight. This refers particularly to the crankshaft which is made of a Nickel Alloy Steel selected because of the uniformly high grade of the material and its resistance to fatigue stresses. Also all gears, either of oil hardened or case hardened steel, which must have both strength and wear resistance to insure long life, are of Nickel Alloy Steel because of its low distortion during heat treating, which insures an accurate gear".

Nickel
FOR ALLOY STEEL

SEND FOR LIST OF AVAILABLE PUBLICATIONS ON NICKEL AND ITS ALLOYS

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

EASIER STARTING



AIRCRAFT engines today are easier to start because Stromberg has developed a carburetor that will supply fuel to the engine at extremely low speeds.

A self-priming well in the Stromberg Aircraft Carburetor makes quick starting possible. The difficulty of low suction in the manifold is overcome. A turn of the propeller draws fuel through the idling well into the manifold — and the engine takes hold instantly.

This is one way Stromberg carburetors have helped make aircraft engines more convenient to operate—more satisfactory to use.

Stromberg engineers, with 22 years of carburetion experience, are at your service on all carburetion problems.

« *Over 95% of the aircraft engines now being built are Stromberg equipped* »

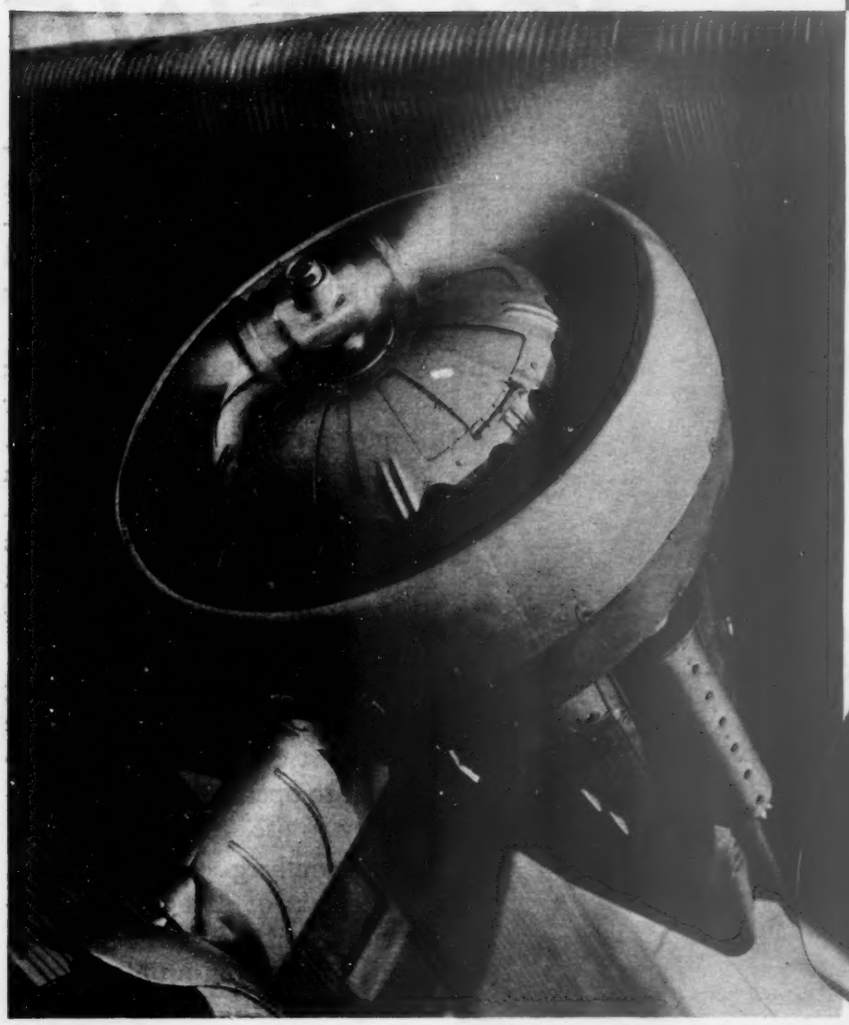
STROMBERG CARBURETORS

BENDIX STROMBERG CARBURETOR COMPANY

« DIVISION OF BENDIX AVIATION CORPORATION »

701 BENDIX DRIVE • SOUTH BEND, INDIANA

WHEN A BEARING FLIES... THERE'S NOTHING BUT PERFORMANCE THAT COUNTS!



Pratt and Whitney Wasp Motor equipped with SKF Anti-Friction Bearings on Ford Tri-Motored Plane.

● *Every aviator knows that "Nothing is apt to cost so much as a bearing that cost so little."*

Along the skyways . . . where chances are always much too long to take . . . where human lives and the development of a new industry depend upon Performance . . . the bearings invariably are SKF.

Men who plan and build the things that fly do not buy on price. Price alone *means* nothing up where wing-tips brush cloud-tips in passing. Performance is the only thing that counts.

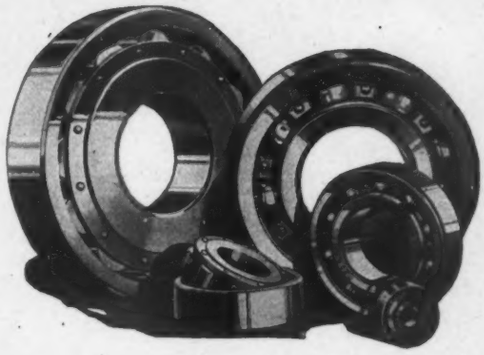
And so today there are more SKF Anti-Friction Bearings in use on aircraft and aircraft equipment than all other makes of bearings combined. SKF Industries, Inc., 40 East 34th St., New York, N. Y.

SKF

Ball and Roller Bearings

2654

PRECISION



FOR BETTER PERFORMANCE

In comparing values, performance should be the determining factor. It is the only true test of worth—gauged not by first cost, but by ultimate cost over a useful life. It is the standard by which true economy must be measured.

In every field of engineering and industry, over a period of twenty years, NORMA-HOFFMANN Precision Bearings have made a distinguished record for dependable stand-up-ability. For greater economy, longer sustained, they stand pre-eminent.

There is a PRECISION Bearing for every load, speed and duty. Let our engineers help you select the type best adapted to your special conditions. And write for the Catalogs.

NORMA-HOFFMANN BEARINGS CORPORATION
STAMFORD CONN., U.S.A.

NORMA-HOFFMANN
PRECISION BEARINGS

BEARINGS

THE TEXAS COMPANY

TEXACO PETROLEUM PRODUCTS

SALES DEPARTMENT
OFFICE OF GENERAL SALES MANAGER
F. M. HAWKS
SUPERINTENDENT AVIATION

October 16, 1930

The Cleveland Pneumatic Tool Co.
Cleveland, Ohio

Gentlemen:

I take great pleasure in advising you that your Aerol Struts, which we are using, not only have proved themselves to be very efficient in absorbing landing shocks, but also add greatly to the cleanliness of the gear construction. Their simplicity, both in installation and operation, is another outstanding accomplishment.

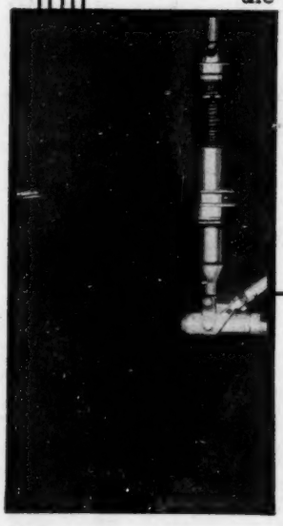
You are to be congratulated on your product and the results it brings to the ones who use it.

Very truly yours,

Frank M. Hawks

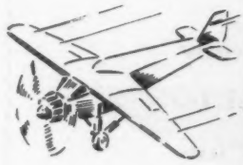
FMH:CES

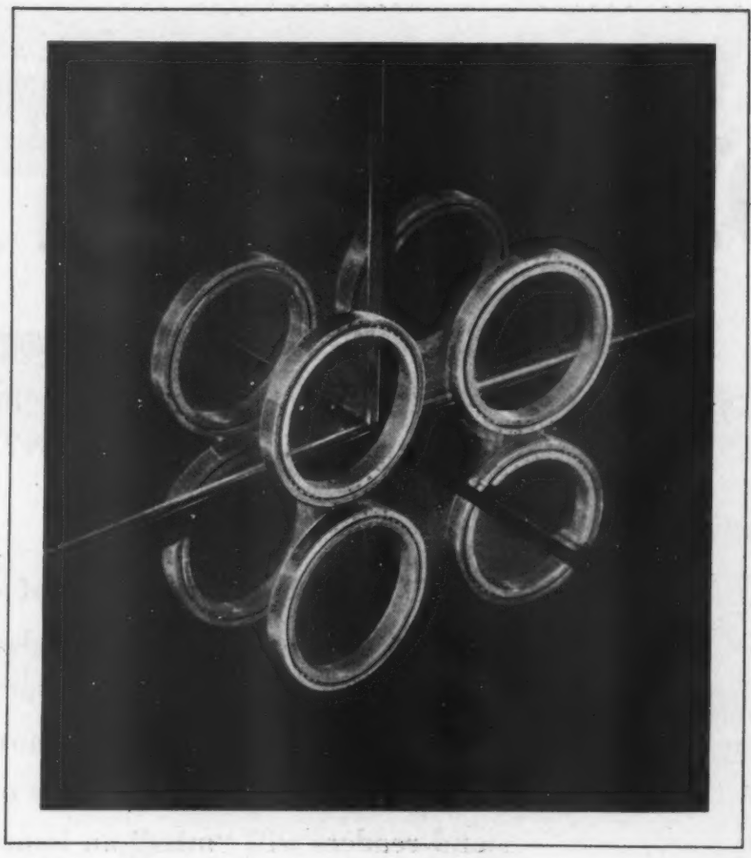
Supt. of Aviation



A TYPICAL expression of opinion from one of America's best-known pilots. Aerol Oleo-Pneumatic Struts have won and held the enthusiasm of pilots the world over. They are manufactured by The Cleveland Pneumatic Tool Co., Cleveland, Ohio.

AEROL shock absorbing STRUT





Knowledge of the Need

DICTATED FAFNIR DESIGN

AIRCRAFT bearings had no precedent on which to base design. With the insistent demand for ball bearings to provide easier operation of controls . . . to make the operation more uniform . . . to reduce the need for maintenance and repairs . . . an intensive study of aircraft needs was conducted by Fafnir engineers.

Witness one of the results as illustrated above. It is a Fafnir Torque Tube Bearing having a very narrow width and an outside diameter only slightly larger than the bore. Great saving in weight is effected and the minimum of space occupied.

This is but one of the designs which Fafnir engineers have developed in conjunction with aircraft engineers and designers. Cartridge types, integral double seal bearings, an inch dimension series and other special types are described in Fafnir Aircraft Data Sheets. Write for copies.

THE FAFNIR BEARING COMPANY., NEW BRITAIN, CONN.
Atlanta Chicago Dallas Milwaukee Detroit Newark New York Philadelphia Cleveland

FAFNIR
BALL BEARINGS

Do you know that . . .

each month our subscription department receives more than 150 requests for "Back" issues of AVIATION?

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If we printed extra copies of our monthly issues, we would be glad to comply with these requests, but unfortunately we have no way of knowing in advance just how many of our newsstand readers will "miss" an issue.

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But We Do Know **— that each of these requests indicates a reader has "missed" just the issue he could make valued use of.**

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Here is my check for $3.00. Send me Aviation for one full year.

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SMOOTHER POWER

Now!

JACOBS ENGINE

As a complete Unit

Specifications

RATED H. P.—150 at 2000 R. P. M.
MAXIMUM H. P. AT SEA LEVEL—
160 at 2100 R. P. M.
WEIGHT OF ENGINE—DRY—390 lbs.
NUMBER OF CYLINDERS—7
DISPLACEMENT—528 Cu. In.
BORE—4½ In.
STROKE—4¾ In.
COMPRESSION RATION—4.8-1
OVERALL DIAMETER—44 In.
OVERALL LENGTH—33 In.

Recommended Cruising Speed
1800 to 1900

A. T. C. 31

And this Smoother Power is now supplied in a complete unit, which includes ply wood mounting board, inner cowling, exhaust collector ring, and N. A. C. A. cowling. A complete power plant, assuring proper cooling . . . simpler installation . . . and the ultimate in performance. Adaptable to any fuselage. The heart of this power plant is the JACOBS 150 . . . a quality engine that has proved its superiority. Production engines now in service with from 500 to 800 hours without a replacement.

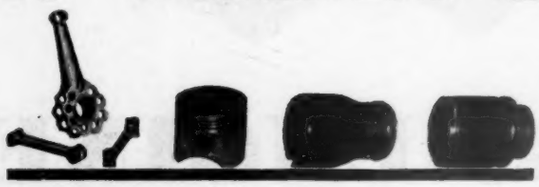
JACOBS AIRCRAFT ENGINE CO.

CENTRAL AJE AIRPORT

CAMDEN, NEW JERSEY

TIME

HAS TURNED THEORIES INTO



FACTS...

UNPROVEN theories have no place in the air, and only the test of time will prove theories as facts. The test of time alone will discover engineering soundness and segregate the practical from the impractical.

Engines may be designed on guesswork, but these engines should be accorded no place in aviation where safety is paramount. Proven theories—facts—are the property of only the best engineers and engineering talent is not hastily developed but built carefully and methodically by years of experience upon a background of solid, proven principles.

At the shops of Govro-Nelson, aviation engine manufacturers are drawing upon the vast resources of theories proposed and developed at the highly regarded Arts & Metiers College of France, tested and proven in a million motor cars on the highways of the world, on the cinder track in famed racing cars and in the air.

At the shops of Govro-Nelson, time has turned theories into facts. Airplane engine manufacturers are using Govro-Nelson machinings with full confidence that they are precisely designed and accurately manufactured with a character fully worthy of their own products.

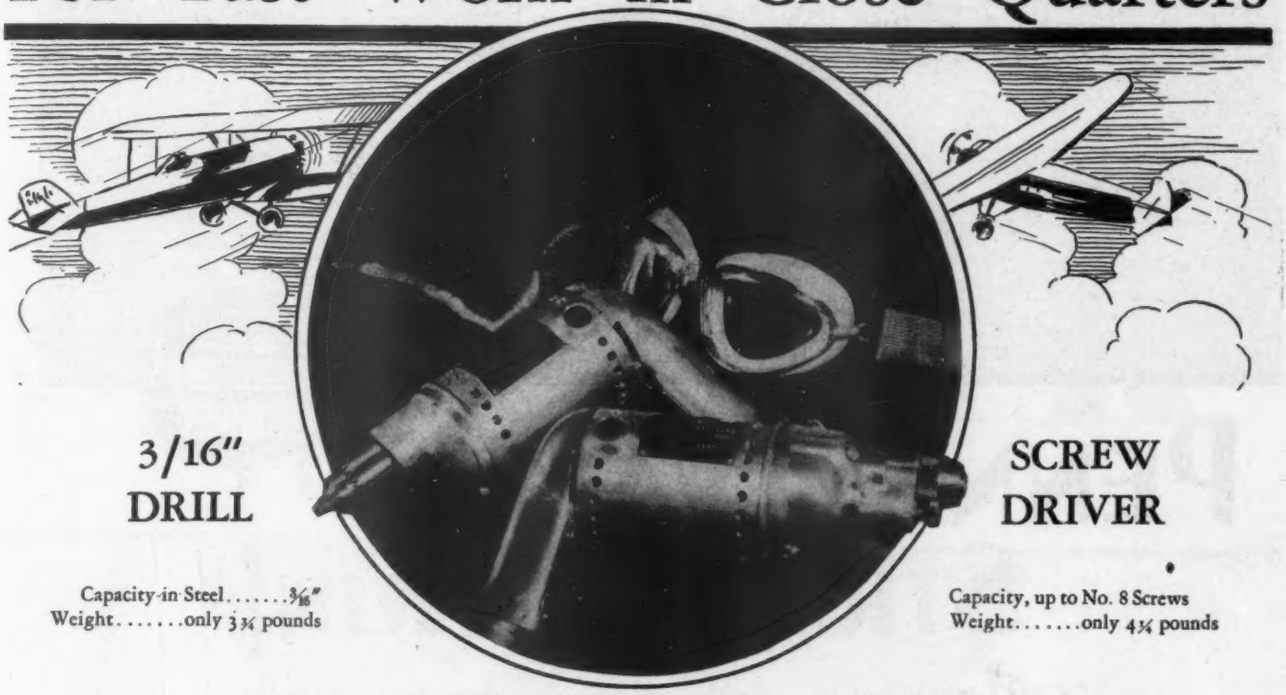
THE GOVRO-NELSON COMPANY

1931 ANTOINETTE DETROIT

CRAFTSMEN TO THE AVIATION INDUSTRY

The NEW UNIVERSAL TWINS

For Fast Work in Close Quarters



3/16" DRILL

Capacity in Steel.....3/16"
Weight.....only 3¾ pounds

SCREW DRIVER

Capacity, up to No. 8 Screws
Weight.....only 4¼ pounds

SMALL in size, light in weight, powerful in operation, the new Black & Decker Universal Twins are designed to do their work with great ease and speed, even in close quarters Small body diameters and rounded exterior surfaces fit the tools to the hand and afford the operators easy grasp in any position. With them your operators can do tedious production or maintenance work in less time, at less cost.

The Screwdriver has an adjustable friction clutch which drives the screw "flush" and releases immediately without danger of marring the screwhead or surrounding surface. Driving tension can be conveniently set with the knurled thumb screw on the gear case. When necessary, the bit can be given an extra turn by a mere pressure of the finger on the clutch control. In addition, this screwdriver has a positive clutch which allows the spindle to remain idle for finding slot in screw, and immediately engages the bit when pressure is exerted. This new unit is ideal for the many light screwdriving applications in airplane assembly and trim work.

The drill is fitted with a 3/16" key-operated chuck. Like its companion, the screwdriver, it has all the features found in the larger Black & Decker Drills. Powerful Universal Motor operates on A. C. or D. C. Ball Bearings on Armature shaft and spindle. Furnished for 110, 220 or 250 volts. This drill is particularly applicable to the requirements of the aviation industry.

See these Time and Labor Saving tools at Your Distributor's—or mail the coupon below for further details of these and other Black & Decker Tools for Aircraft Production and Maintenance

BLACK & DECKER

TOWSON, MARYLAND, U. S. A.

Slough, Bucks., England | **Toronto, Ontario, Canada** | **Sydney, Australia**

Fill Out and Mail Today! A

The BLACK & DECKER MFG. CO.
TOWSON, MARYLAND, U. S. A.

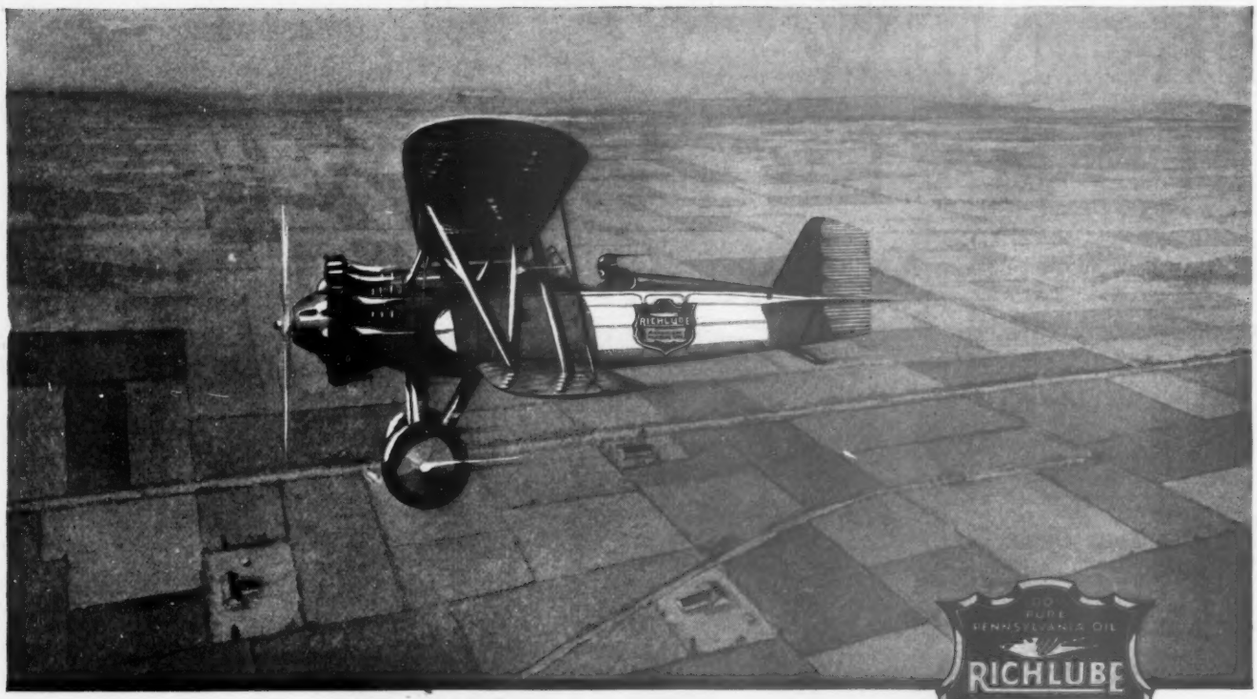
Send literature describing Universal Twins and other Electric Tools for Aircraft Production and Maintenance.

Name.....

Firm.....

Address.....

Distributor's Name.....



PENNSYLVANIA STRAIGHT-RUN!

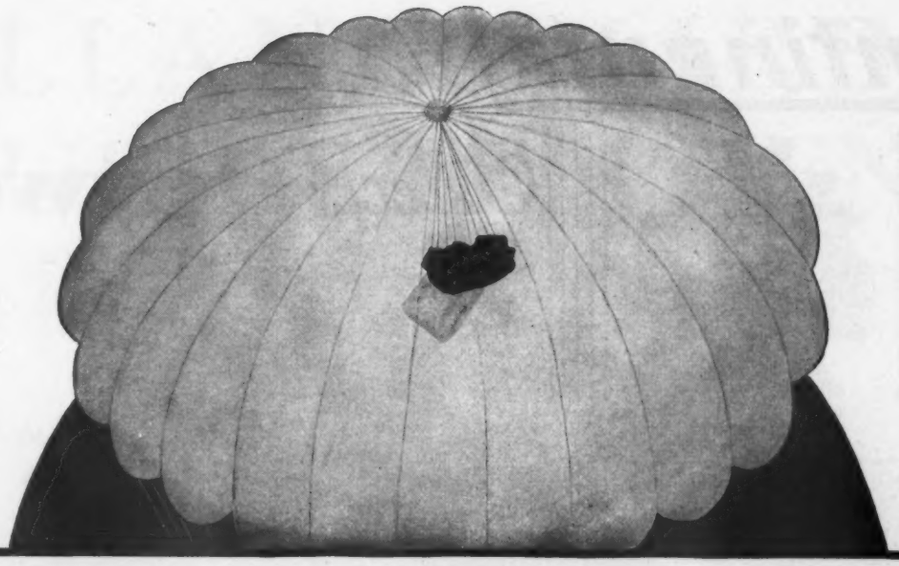
THAT means just this...Richlube is 100% pure Pennsylvania oil made entirely from choice Pennsylvania crudes. It is not blended with cheaper stocks! Because Richfield insists on the highest quality possible ...it operates its own refinery in the heart of the Pennsylvania crude district where its engineers personally supervise the refining . . . to make sure that every gallon is fine enough to carry the Richlube label.

Richlube is Approved by Every Major Aircraft Engine Manufacturer in the United States

Here is indisputable proof of Richlube quality...this sweeping tribute by the nation's most famous motor manufacturers. Add to this...the fact that Richlube has played a prominent part in many of aviation's greatest achievements. That it is used in daily service by leading air transport lines of the country! Try Richlube in your own plane...available at important airports both east and west of the Mississippi River.

RICHFIELD OIL COMPANY • Los Angeles • New York City

RICHFIELD



SWITLIK

SAFETY CHUTES

Reduced to

Now you can get a famous SWITLIK SAFETY CHUTE at a greatly reduced price. Silk fabric prices are now the lowest in years and while they stay low, we are giving you the benefit of this tremendous saving to boost Aviation and safer flying. With the finest silk canopy our new price gives you a saving of $75, and with the proved Pongee Silk canopy, a saving of $60.

$300
FOR WHITE SILK

and

$240
FOR PONGEE SILK

So—order your SWITLIK CHUTE now. Get one of these proved superior parachutes with the patented one-piece combination pack cover and pilot chute, at a lower price than you would pay for an ordinary chute. Write or wire at once. Every SWITLIK SAFETY CHUTE drop tested and approved with A. T. C. Responsible dealers are invited to write for splendid proposition.

SWITLIK
PARACHUTE & EQUIPMENT
COMPANY
TRENTON NEW JERSEY

USED BY DEPARTMENT OF COMMERCE OFFICIALS, AIRMAIL PILOTS AND FAMOUS FLYERS

Continental Selects Heywood

for this Service Plane

In the field of engine design and manufacture "Continental" is indeed a recognized standard. For years "Continental" and "Motors" have been synonymous in the minds of millions.

And with that intolerance of mediocrity which distinguishes a leader, Continental selects a Heywood Starter for their own field and service plane shown above.

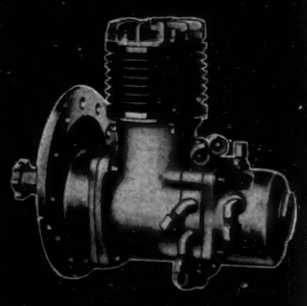
Surely the experience and judgment which dictates the selection of Heywood should mean much to plane owners.

The simplicity of operation—absolute dependability—and above all, the convenience of starting from the operator's seat afforded by the Heywood, are the least upon which the up-to-date pilot should insist.

The Heywood Starter is made of Bohnalite—62% lighter than iron—and is adaptable to all standard engines. Write for descriptive pamphlet.

START-ER *by* HEYWOOD

HEYWOOD STARTERS

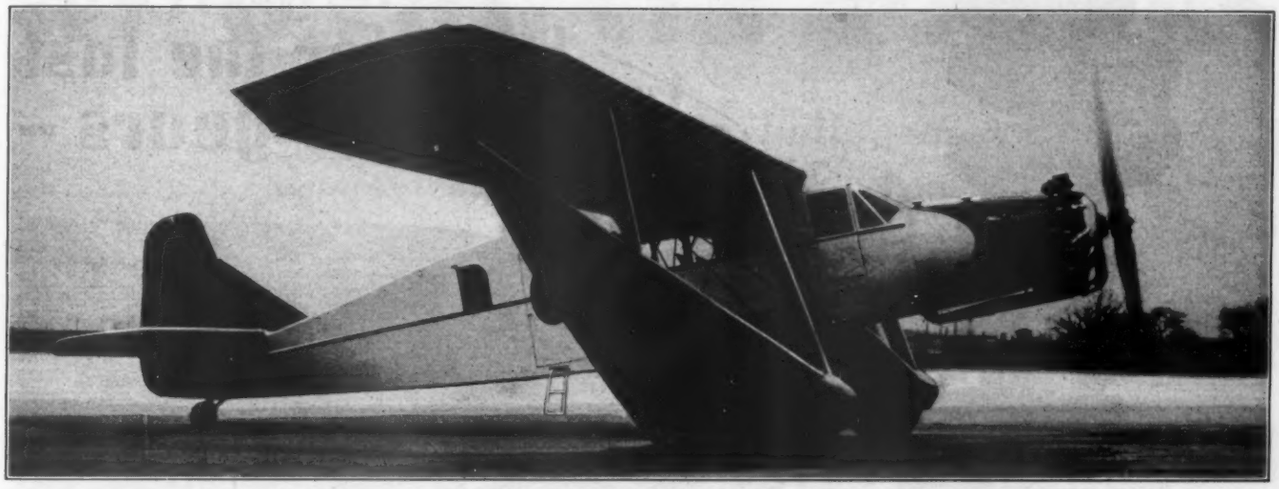


SKY SPECIALTIES CORPORATION

3651 Hart Avenue • • Detroit, Michigan

SKY SERVICE

BELLANCA AIRBUS DOUBLES EFFICIENCY of AIR TRANSPORTATION



Nose of the Airbus, showing baggage-freight compartment with capacity of 18 cu.ft. or 450 lbs.

Entering Airbus cabin. Wide, full-height door at each side of fuselage. Retractable steps.

Deep-cushioned, steel-frame seats. Note baggage compartments beneath seat data.

PAYLOAD: twice that of other single-engine transport airplanes of similar horsepower and operating cost.

OPERATING COST: half that of multi-engine transport airplanes of similar payload capacity.

SAFETY: Due to that perfection of flying qualities, control, and quiet comfort which only the simple single-engine airplane provides, as the history of aviation has proved.

THE RESULT: Earning capacity far beyond that of any aircraft as yet produced.

Seating Capacity: 12 persons.

Payload (with 700 miles cruising range and Cyclone engine): 2,945 lbs. This figure includes 11 passengers and 1,075 lbs. of baggage, mail and freight. In the case of freight only, this payload may be considerably increased.

Cruising Speed (at 2/3 full power): 118 to 126 m.p.h., according to type of engine.

Department of Commerce Approved Type Certificates:

No. 360, with water-cooled 600-hp. Curtiss Conqueror Engine.

No. 391, with 600 hp. air-cooled Wright Cyclone Engine

BELLANCA AIRCRAFT CORPORATION

New Castle, Delaware

New York Office: Chrysler Building

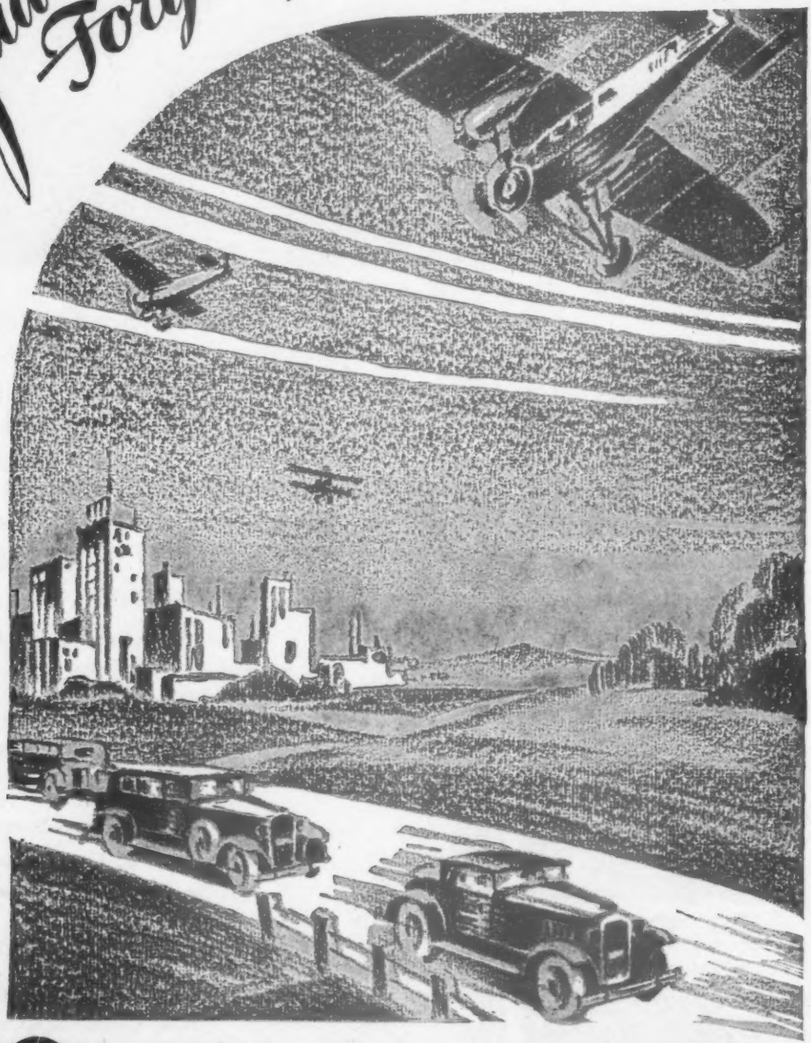
Canadian Distributors:
Bellanca Aircraft of Canada, Ltd., Montreal

BELLANCA

ON THE AIRWAYS TO-DAY

Guaranteed Forgings

– as on the highways for the last 30 years –



WYMAN-GORDON

WORCESTER, MASS.
AND HARVEY, ILL.

FOKKER

demonstrators

AT BARGAIN PRICES

All Fokker planes, including these demonstrators, can be purchased on the convenient GMAC time payment plan

We can't call these ships new, although they have been flown only by our own pilots for demonstration purposes.

But they are "new" in reliability—in mechanical condition—in appearance inside and out and fully guaranteed by us, same as new planes.

Every hour they spent in the air is generously taken out of the price. The number is naturally limited, but subject to prior sale we list the following models:

STANDARD UNIVERSAL	F-10A TRIMOTOR
SUPER-UNIVERSAL	F-11A AMPHIBION
F-14A MAIL PLANE	F-32

Responsible operators or individuals with fixed bases, can secure attractive terms of lease.

TELEPHONE Circle 7-5720—WIRE OR WRITE

FOKKER

Aircraft Corporation of America

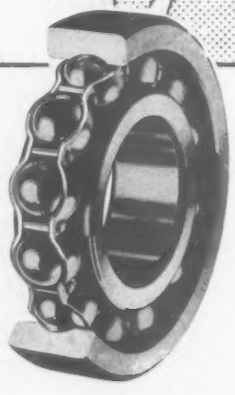
AFFILIATED WITH GENERAL MOTORS CORPORATION

GENERAL MOTORS BUILDING, 1775 BROADWAY, NEW YORK

SRB BALL BEARINGS *used throughout the* LYCOMING ENGINES *on these* STINSON TRI-MOTORED PLANES

Stinson is a name long known to aviation. No less established is the prestige of Lycoming—noted manufacturer of dependable motors. In each Lycoming motor of these Stinson airliners a total of 39 SRB Ball Bearings is used. One No. 213 single row bearing takes the propeller thrust; two No. 214 single row bearings support the crank shaft and 36 SRB lubri-seal bearings are used on the rocker arms.

SRB Ball Bearings with the maximum number of large balls, hot forged from Molybdenum steel, provide the utmost in capacity and reliability so essential in aircraft engine service.

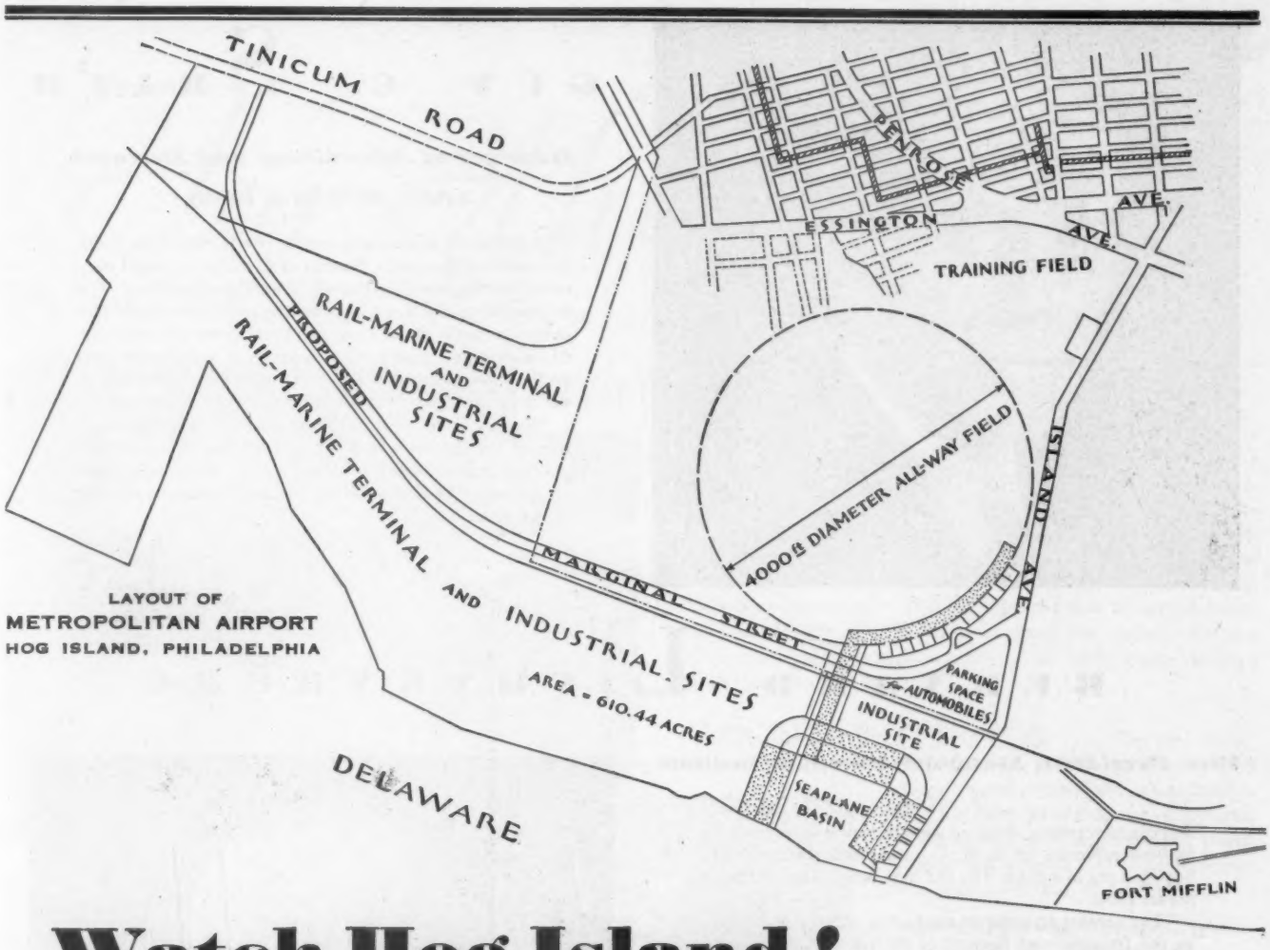


STANDARD STEEL AND BEARINGS, INCORPORATED

Plainville ***Connecticut***

DIVISION OF MARLIN-ROCKWELL CORPORATION

Ball SRB Bearings



LAYOUT OF
METROPOLITAN AIRPORT
HOG ISLAND, PHILADELPHIA

Watch Hog Island!

... Here will be offered to aircraft manufacturers

The best manufacturing sites in America, bar none!

Transportation Facilities in the Philadelphia Area
Distribution and Production in the Philadelphia Area
Power Resources in the Philadelphia Area
Labor and Human Resources in the Philadelphia Area

Philadelphia affords in favorable *balance* all important factors for industrial and commercial progress. These free booklets give the important facts.

Hog Island, famed as the country's war-time shipbuilding center, is now being cleared for the construction of what is expected to be America's most comprehensive air terminal.

It is proposed to spend between four and five million dollars for the development of the Philadelphia Airport, which will occupy approximately 600 acres. A similar area of approximately 600 acres immediately adjacent to the Philadelphia Airport will be available for marine and industrial development.

On request, the technical staff of this Association will prepare and submit specific data applying to Philadelphia's opportunity for you. Please address Department B. C. on your business letterhead.

PHILADELPHIA

Business Progress Association

1442 Widener Building, Philadelphia

GUY C. SMITH

Manager of Advertising and Research

Libby, McNeill & Libby

"Any American advertising manager who wants to learn the value of the Audit Bureau of Circulations need only start buying newspaper space in foreign countries. The impossibility of knowing accurately, without special and costly research, the amount and breakdown of circulation of publications in any other country, is a sharp contrast to the information which has become available to advertising in this country by reason of the work of the A. B. C.

"But the Bureau needs the support of every important user of publication space. In my opinion it has not begun to reach any limit of its usefulness. I consider it one of the most fundamental advertising expenditures our company makes."

Guy C. Smith

BERNARD LICHTENBERG

***Vice President*, Alexander Hamilton Institute**

"Buying advertising space in newspapers and periodicals without referring to A. B. C. circulation audits is like buying a pig in a poke. The old time farmers never traded horses blind.

"The earnest attempt on the part of such organizations as the Incorporated Society of British Advertisers, the Australian Association of National Advertisers, the German Reklame-Schutzverband, and the Mexican Associacion de Annunciantes, among others, to form an Audit Bureau in their countries based on our own A. B. C., is an indication of the fact that thoughtful advertisers around the world have seen the worth of such an organization."

Bernard Lichtenberg

● Twenty years ago there was chaos in advertising. Nobody knew what his dollars bought—whether a thousand readers or ten thousand. Nobody, except by infinite pains and shrewdness, could find out.

Could advertising, on that basis, ever have grown to its present importance? Would business ever have rested its trust in a sales weapon of metal so doubtful in assay?

Hardly, think men who today direct advertising expenditures that total millions. Through such leaders as these the Audit Bureau of Circulations came to be organized. And largely through the activities of the Bureau, there is order today in the buying of advertising space.

Once a year now, into almost every important publication office, go the auditors of the A. B. C. Every circulation record is open to them.

To no publisher, no agency are they responsible. They work directly for the Audit Bureau of Circulations, and on the directorate of this institution a majority must be advertisers.

The Bureau's Audit Reports thus give the detailed findings of experts controlled by advertisers. They bring to light the complete circulation facts.

Can any budget yield full returns without use of this only recognized method of appraising advertising space?

Can any important advertiser, whether national or local, afford to be unrepresented upon the membership roster of the Audit Bureau of Circulations?

An Advertisement by the
AUDIT BUREAU OF CIRCULATIONS

Executive Offices • • • Chicago

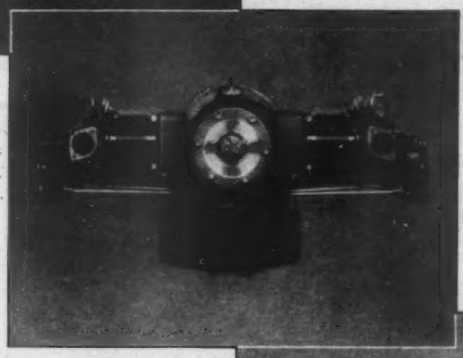
Far Ahead . . .

in APPEARANCE . . CONSTRUCTION . and PERFORMANCE

AERONCA DUPLEX C-3 . . . At last . . . a two-passenger Aeronca retaining the phenomenal performance of the single seater. This dual control, with seats side-by-side permitting easy conversation in pleasure flying and direct observation by students during training, renders obsolete the conventional tandem-type two-seaters. Powered with the new 40 h.p. Aeronca motor and reflecting quality in every detail, the Aeronca Duplex C-3 has the strength, comfort and superior performance of ships costing three times as much.

AERONCA E-113 MOTOR . . . This new motor, with its steel cylinders, overhead valves, roller-bearing crankshaft and ball-bearing camshaft, is unquestionably the most powerful and completely reliable two-cylinder engine in the world. It gives the Duplex C-3 a performance exceeding even that of the C-2.

Advanced features of style, reliability and safety, a price range well below $2,000, and an operating cost of approximately 70 cents an hour, place Aeronca planes in a position of absolute dominance in the private owner field.

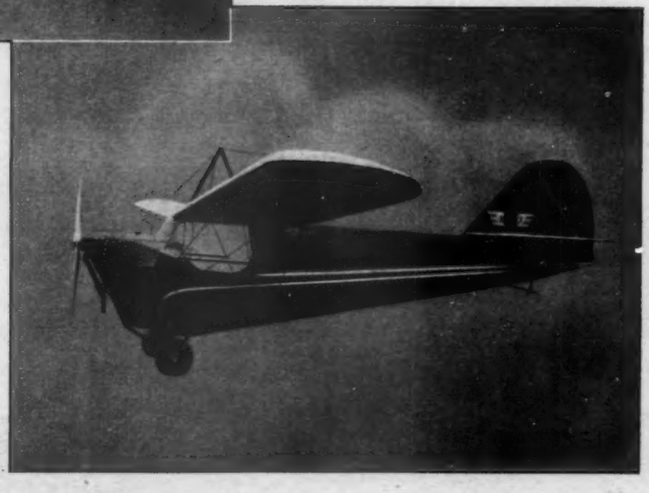


LAST year was epochal in the aircraft industry. It saw the opening of the great private owner market through the introduction of the first practical light airplane . . . the now famous Aeronca C-2.

Extraordinary performance attracted immediate attention to this new plane . . . with its 70-foot take-off; its rapid climb; its amazing stability and exceptional responsiveness. Novices learned to fly it in two to four hours; sportsmen revelled in its extraordinary safety; its enormous gliding angle and its unbelievably slow landing speed. These qualities combined with its unprecedented economy of operation . . . about one cent per mile . . . made the Aeronca C-2 the nation-wide sensation of the industry. The public saw, tried and bought!

Now, while others are vainly striving to duplicate Aeronca performance, and to approach our 1930 standards, we are enhancing our acknowledged leadership by producing 1931 Aeroncas that actually *surpass* those standards.

AERONCA DELUXE C-2 . . . Without altering areas or aerodynamic design of the original Aeronca C-2, we have added greatly to its appearance, comfort and convenience. Wide strut-type landing gear; improved semi-cabin type windshield; wider fuselage for accessibility; improved upholstering of seats and back rests; enclosed baggage compartment; all combine to make the DeLuxe C-2 as superior in appearance and comfort as in performance.

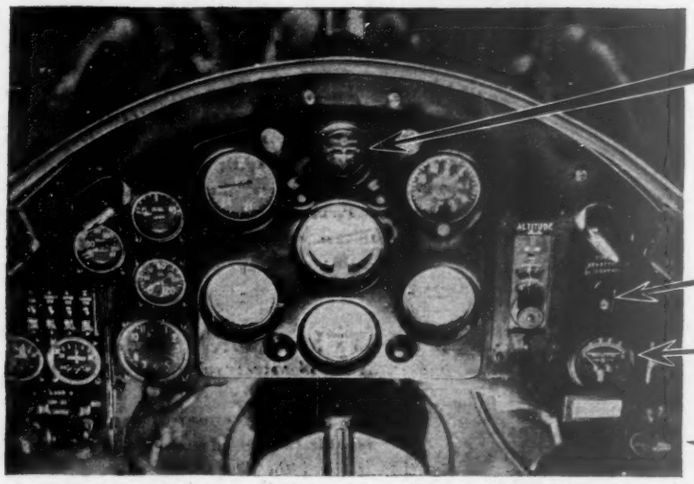


Dealer contracts now being closed. Some choice territories still open. Write or wire for details.

THE AERONAUTICAL CORPORATION OF AMERICA

LUNKEN AIRPORT — AERONCA — CINCINNATI, OHIO

Selected for Foreign Service



Course indicator for magneto compass

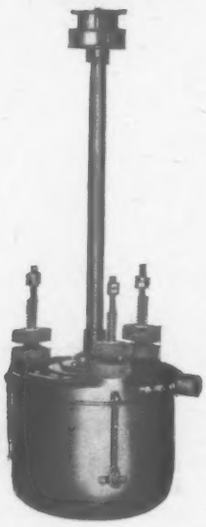
Compass sensitivity controller

Engine-temperature indicator

Course-setting controller

A Tribute to the Reliability of G-E Instruments

HIGH speed, comfort, and reliability are necessary characteristics of this special Detroit-Lockheed airplane selected by Lieutenant Commander Glen Kidston, famous British flier and sportsman, for service in Africa and Europe. Its equipment includes, among other reliable and accurate instruments, a General Electric magneto compass and engine-temperature indicator. The selection of these instruments is an indication of the confidence won by G-E equipment among experienced pilots at home and abroad. Let us send you complete information. General Electric Company, SCHENECTADY, NEW YORK.



Magneto compass generating unit

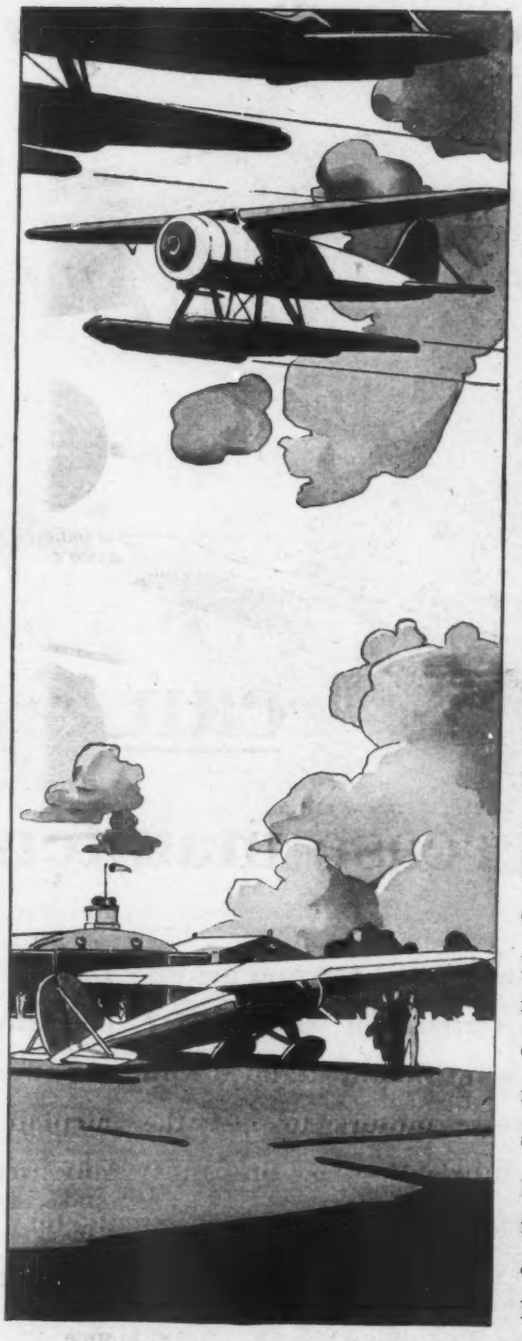
GENERAL ELECTRIC

AËRONAUTIC EQUIPMENT

700-9

SPECIALISTS IN NEW YORK, WASHINGTON, DAYTON, AND LOS ANGELES

THE FLEETSTER Model 17 is a single-engined cabin monoplane, built for strenuous service. It accommodates seven passengers in addition to pilot and luggage, and is provided with spacious windows on each side of the main cabin, with a door on the left side. The pilot's cockpit is forward of the main cabin. Seats are of the deep lounge type. The exterior and interior color schemes are optional with the customer ● With its high speed of 180 miles an hour, and its cruising speed of 153 miles an hour, The FLEETSTER Model 17 is a highly profitable carrier for fast and frequent passenger service, or as an economical auxiliary to larger transport equipment where traffic volume is variable ● Transport operators are invited to write for cost figures compiled from FLEETSTER operation and service—facts which will prove most helpful to their interests in planning an extension, or a re-adjustment of their present operation.



Traveling executives in increasing numbers are taking to the air. In directing or supervising operations at distant points, or branch establishments over a wide range of territory, The FLEETSTER Model 17, convertible landplane or seaplane, provides such business men with safe, speedy and comfortable transportation . . . a flying office, equipped with every accommodation, where business may be transacted en route at a saving of valuable time ● For the man of independent means who takes to flying as he did to motoring or yachting, The FLEETSTER Model 17 offers a new sensation—a sporting thrill—and a highly gratifying convenience as a means of quick transport between widely separated interests . . . from city to shore, or country place . . . to resorts, meets, or other event ● If you are interested in private air transportation for your corporation, firm, or self, write for facts concerning the adaptation of The FLEETSTER to business needs.

THE FLEETSTER MODEL 17

CONSOLIDATED AIRCRAFT CORPORATION · BUFFALO, NEW YORK

Proper Lubrication

can

decrease maintenance costs

How many hours can you get between overhauls of your motor? If you want the most and if you want your motors to last the limit, lubrication is the most important consideration.

Gulfpride Oils are manufactured specially for the job of preventing wear on moving parts of airplane motors. Their use in *any* aircraft motor assures satisfactory oil performance.

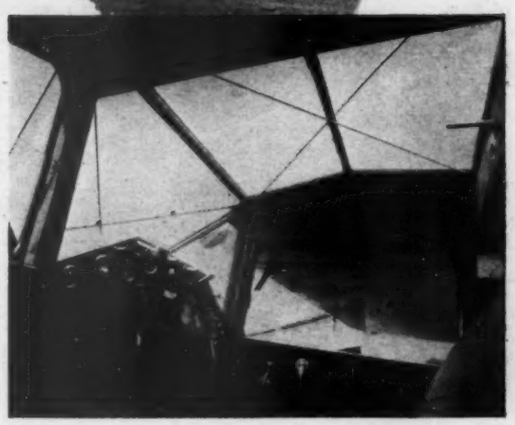
GULF *Gulfpride Oils* **DO!**

GULF REFINING COMPANY

Pittsburgh **Pennsylvania**

Swanson

Announcing the FULL VISION COUPE



AT last, a true cantilever monoplane in which *unobstructed overhead vision* is achieved through use of the Swanson patented wing truss.

Designed for private ownership and student instruction and approved by the Dept. of Commerce, the Swanson W-15, side by side coupe is powered with the 110 h.p. Warner Scarab engine, giving ample reserve power and a high speed of 125 miles per hour.

The Swanson Coupe combines, with excellent flying qualities, sturdiness, beauty of line, luxurious appointments, complete modern equipment and low operating and maintenance costs.

This machine will not go into a spin from an ordinary stall. If forced into a spin it returns immediately to normal flying position when controls are neutralized.

In the design of the Swanson Coupe, careful attention has been given to maintenance features. Wing panels are quickly demountable. Student controls may be quickly connected or detached. Rigging adjustments may be quickly and easily made. All structural parts are completely interchangeable without hand fitting.

Wide doors, luggage compartment for two suit cases, seats adjustable for wearing seat pack parachute in comfort and numerous other improvements in detail design.

The Swanson Coupe is offered in two models—Standard and De Luxe. Equipment on both models consists of dual controls, low pressure semi-balloon tires, laminated safety glass, usual instruments and fire extinguisher, split type landing gear, Oildraulic shock absorbers, removable axles, brakes, full castering wheel.

The De Luxe model is equipped with Eclipse direct cranking starter, engine driven generator, special aircraft storage battery, navigation and landing lights, cabin and instrument board lights, Hamilton Standard steel propeller, heater and extra instruments including compass, air speed indicator, clock, bank indicator, ammeter, switches, etc.

Prices Flyaway Hopewell Va; Standard Model $4,450. De Luxe Model $4,985.

SPECIFICATIONS AND PERFORMANCE DATA:

Span	34 ft. 4 in.
Length overall	25 ft.
Height	7 ft. 7 in.
Weight empty—Standard equip'mt	1,325 lbs.
Weight empty—De Luxe equip'mt	1,400 lbs.
Gross weight—De Luxe equip'mt	2,050 lbs.
Power loading, maximum	18.65 lbs. h.p.
Fuel capacity	40 gals.
Oil capacity	3 gals.
Useful load—Standard equip'mt	725 lbs.
Useful load—De Luxe equip'mt	650 lbs.
Payload—Standard equipment	295 lbs.
Payload—De Luxe equipment	220 lbs.
High speed	125 m.p.h.
Cruising speed	95 m.p.h.
Landing speed	40 m.p.h.
Cruising radius	625 mi.
Duration	6½ hrs.
Rate of climb from sea level:	
Light	1,000 ft. per min.
With full load	700 ft. per min.
Ceiling, absolute	16,000 ft.

Send for complete details

SWANSON

SWANSON AIRCRAFT CO., Inc.

HOPEWELL...VIRGINIA

WHEN TIME IS MONEY . . . FLY!

YOU will often find it just as important to let your product or your message fly! . . . Strangely enough, the United States, which is so dependent upon swift transportation in order to promote and maintain national business, does not realize the value of Air-Express.

There is room here for profitable and constructive business!

It is significant that the great flight of a squadron of Italian planes across the South Atlantic received relatively slight attention. The world has grown accustomed to long flight and is getting rapidly away from pioneering days, except in countries that are also backward in other forms of transportation. Seasoned travelers are becoming accustomed to airplane service. Double sections are flown between Chicago and New York in six and a quarter hours! Gardenias are sold in wintry New York thirty-six hours after leaving sunny California!

There is money in air-express, both to shipper and operator.

A new transcontinental air-express has recently been opened, which will carry packages up to 200 pounds weight from coast to coast in 36 hours. In addition to this, there are several services which connect with the great air-express services of Europe. It is literally possible today for the people of Cairo and Bagdad to see moving-picture releases as promptly as on continental America—*within two weeks after air-shipment from Hollywood!*

Ford tri-motored, all-metal planes have established themselves in all climates and under all conditions as swift, capacious cargo-carriers, built for speed, economy and extraordinary durability. Ford commercial transport planes have written a marvelous record in the sky.

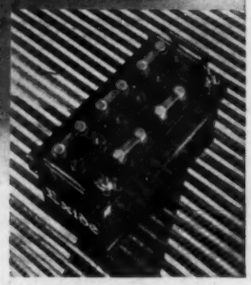
There is no long-haul transportation service of any sort that has made large profits out of carrying passengers only. It is the "meat below deck" that pays the profit on ocean liners. Ford planes are designed for every service, and have been proved in every service.

• FORD MOTOR COMPANY •

When FOG
Blankets the "Hell Stretch"

dependable Exides keep pilots on the course, via Radiophone

Winging through the fog. Depending on radio for guidance. The pilot who has Exides aboard is safeguarded. He knows what weather to expect ahead. The condition of landing fields.



Exide Aircraft Battery—a battery made to fly. Light-weight —compact—safe.

Dense fog. Flying blind. Only radio to tell him whether he is on the course and of weather conditions ahead.

Exide Aircraft Batteries help make radio *certain*—and do other jobs just as dependably. They furnish current for landing, avigation and instrument lights—starting and ignition. Exides have proved their worth over millions of miles of sky lanes. They are so designed that the electrolyte will not spill—even in the hardest kind of flying service. This is but one of many reasons why they are preferred.

Ask your flying friends about Exide reliability. Or write today for further information about the many types of Exide Aircraft Batteries. One-seater "mono" or cabin plane—there's an Exide to fill the bill.

Exide
AIRCRAFT
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia

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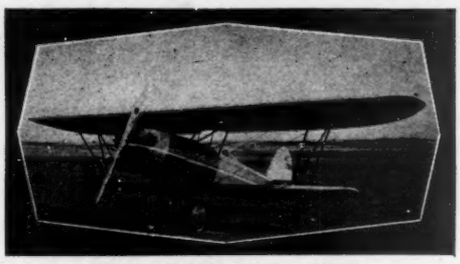

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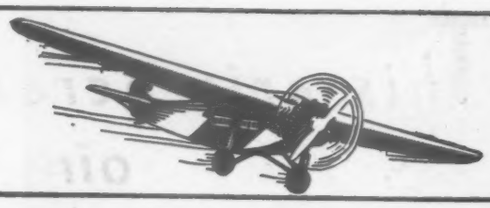

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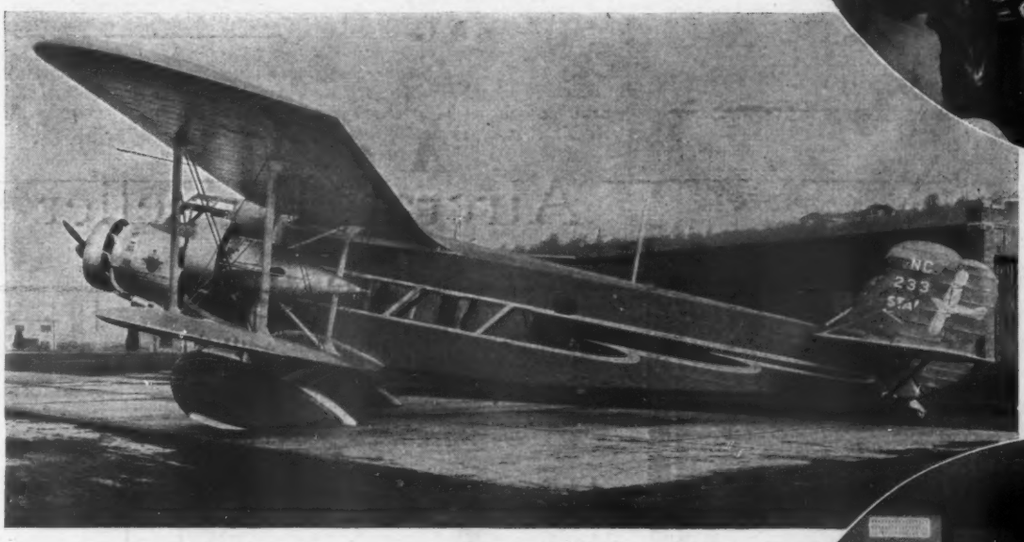

Left—The new Boeing-built flagship of the Standard air fleet, powered with three 525 h.p. Hornet motors. Above—Passengers at bridge in the richly finished cabin. Below—View aft showing another arrangement of seats, with passengers enjoying an amusement broadcast.

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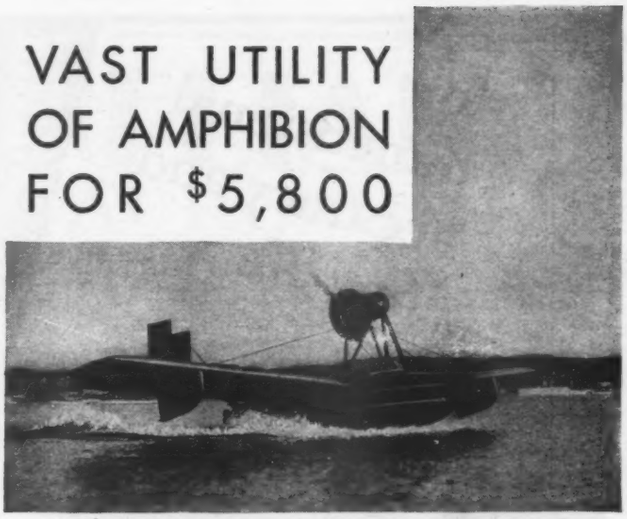

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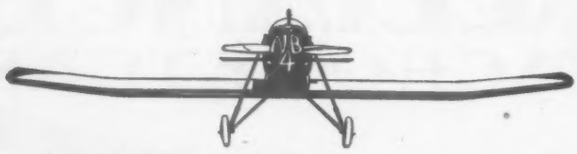

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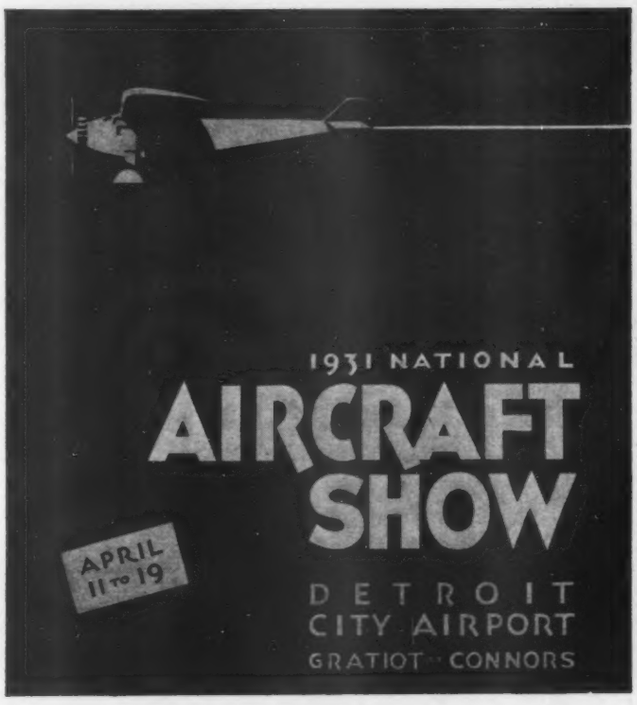

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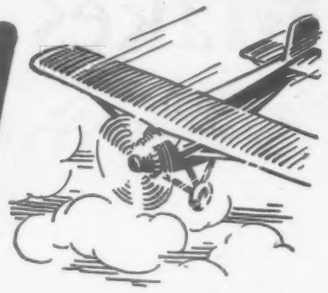

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Bradley Jones is Professor of Aeronautic Engineering at the University of Cincinnati—and was for seven years Navigation Engineer at Wright Field.

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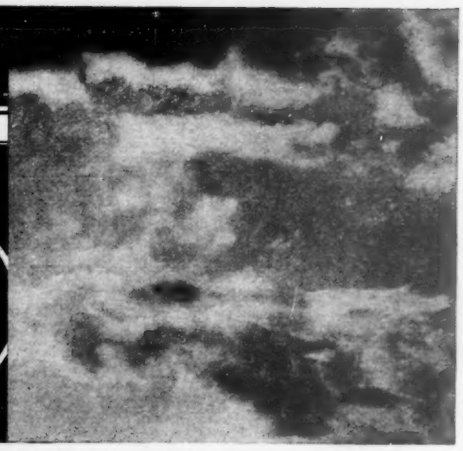

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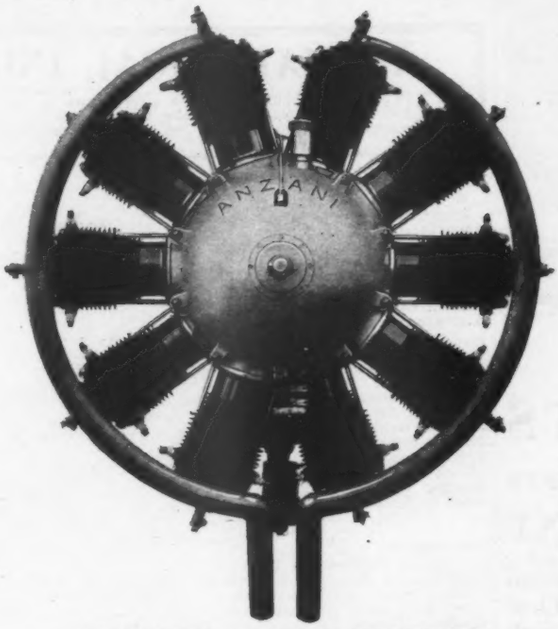

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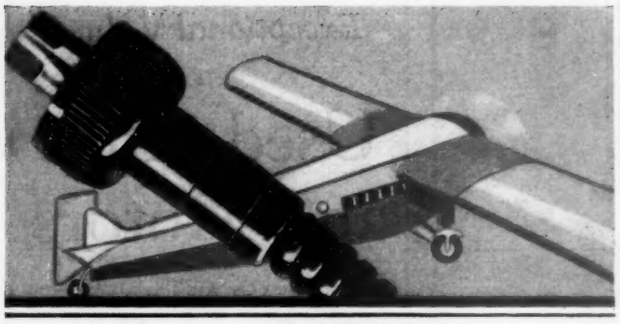

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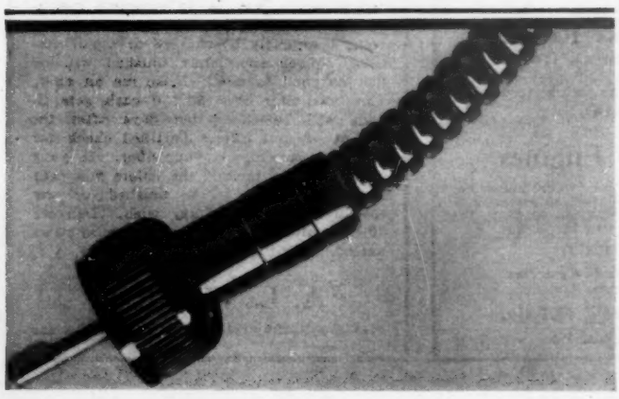


ALPHABETICAL INDEX

This index is published as a convenience to the reader. Every care is taken to make it accurate, but *Aviation* assumes no responsibility for errors or omissions.

Name	Page
Aeronautical Corp. of America	49
Albertson & Co.	23
Aluminum Corp. of America	29
American Screw Co.	69
Amphibions, Inc.	65
Anchor Post Fence Co.	20
Austin Company, The	8
Autogiro Company of America	6-7
Barbour-Stockwell Co.	67
Barnes Co., Wallace	79
Barnes, Gibson & Raymond, Inc.	62
Bellanca Aircraft Corp.	43
Bendix Brake Co.	21
Bendix-Stromberg Carburetor Co.	31
Bird Aircraft Co.	56
Black & Decker Mfg. Co.	39
Boeing Airplane Co.	63
Boeing School of Aeronautics	62
Chamberlin, Clarence D.	64
Cleveland Pneumatic Tool Co.	34
Continental Aircraft Engine Co.	25
Consolidated Aircraft Corp.	51
Curtiss-Wright Airplane Co.	11-12-13-14-15
Cyclone Fence Co.	71
Eclipse Aviation Corp.	Second Cover
Electric Storage Battery Co.	55
Fafnir Bearing Co.	35
Fairchild Aerial Camera Co.	5
Fairchild Aviation Corp.	60
Fokker Aircraft Corp. of America	45
General Electric Company	50
Gibson Co., The Wm. D.	70
Gilbert & Barker Mfg. Co.	3
Goodyear Tire & Rubber Co.	19
Govro-Nelson Co.	38
Great Lakes Aircraft Corp.	59
Gulf Refining Co.	52
Hartshorn Co., Stewart	65
Heath Airplane Corp.	17
International Nickel Co.	30
Irving Air Chute Co.	2
Jacobs Aircraft Engine Co.	37
Martin Co., The Glenn L.	Third Cover
McGraw-Hill Book Co.	64
Meyrowitz, Inc., E. B.	70
National Aircraft Show	69
Nicholas-Beazley Airplane Co.	68
Norma-Hoffmann Bearings Corp.	30
Ohio Seamless Tube Co.	72
Overland Airways, Inc.	64
Packard Motor Car Co.	58
Page Fence Co.	68
Parker Kalon Corp.	16
P.M.A.C.	66
Pennzoil Company	22
Perry-Austen Mfg. Co.	66
Philadelphia Business Progress Association	47
Pioneer Instrument Co.	80
Pratt & Whitney Aircraft Co.	First Cover
Pyrene Mfg. Co.	62
Raymond Mfg. Co.	66
Richfield Oil Co.	40
Roebling's Sons Co., John A.	57
Scintilla Magneto Corp.	79
Searchlight	73-74-75-76-77
Service Steel Co.	67
S.K.F. Industries, Inc.	32
Sky Specialties Corp.	42
Stanavo Specification Board	26-27
Standard Oil Co. of N. Y.	28
Standard Steel & Bearings, Inc.	46
Stromberg-Carlson Tel. Mfg. Co.	70
Summerill Tubing Co.	4
Swanson Aircraft Co.	53
Switlik Parachute & Equipment Co.	41

Name	Page
Thompson Products, Inc.	24
Texas Co., The	10
Timken Roller Bearing Co., The	9
Vought Corp., Chance	18
Waco Aircraft Co.	72
Western Electric Co.	61
White Dental Mfg. Co., S. S., The	78
Wiley & Sons, Inc., John	70
Williams Co., J. H.	68
Wright Aeronautical Corp.	Fourth Cover
Wyman-Gordon Co.	44
Zapon Co., The	71

Searchlight

Classified Advertising

BOOKS	75
POSITIONS VACANT	74
POSITIONS WANTED	74-75
MISCELLANEOUS	75
BLUE PRINTS	75
BUSINESS OPPORTUNITIES	75
REPRESENTATIVES WANTED	75
SALESMEN WANTED	75
TRADE	76
USED AND SURPLUS EQUIPMENT	75-77
WANTED TO PURCHASE	76

Aircraft Service Directory

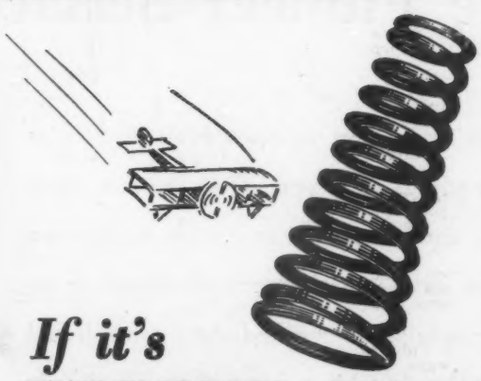
Air Transport Equip. Co., Inc.	74
Boston Auto Gage Co.	74
Bowers Mfg. Co.	74
Posey & Co., J. V. G.	74
State Mfg. & Eng. Co.	74
Sweebrock Aviation Co.	74

Professional Services

Lancaster, Allwine & Rommel	74
National Aircraft Engineers, Inc.	74
Polachek, Z. H.	74
Roberts (M. E.) E. W.	74
Tilgner, Jr., C. E., Charles	74

Where to Fly

Page	73



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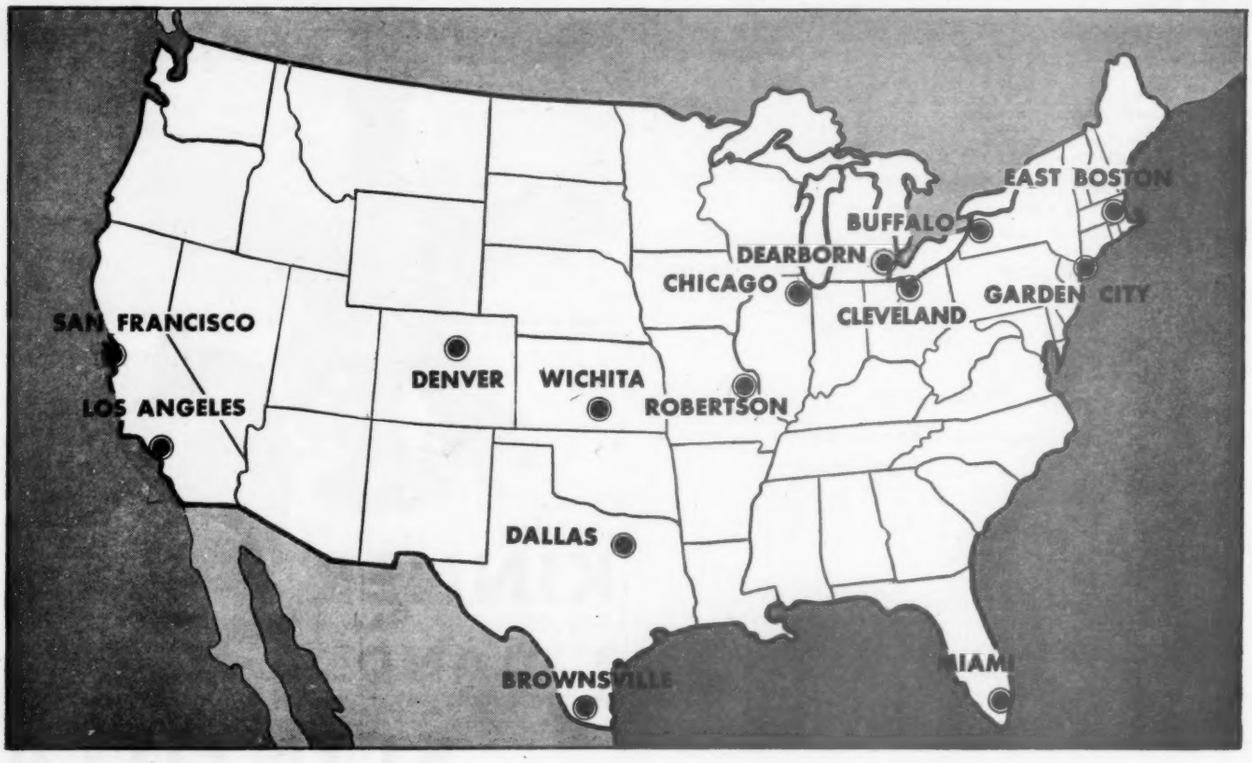

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The new PM-1 Martin Flying Boat, the latest service type coast patrol bomber.

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★ In the ordinary run of production, good engineering, supplemented by efficient manufacturing, is accepted as sufficient. But not in the MARTIN plant. Here every part of every plane must pass a vast series of laboratory tests before it receives an O. K. Tests that impose far greater strain than the plane could experience in flight.

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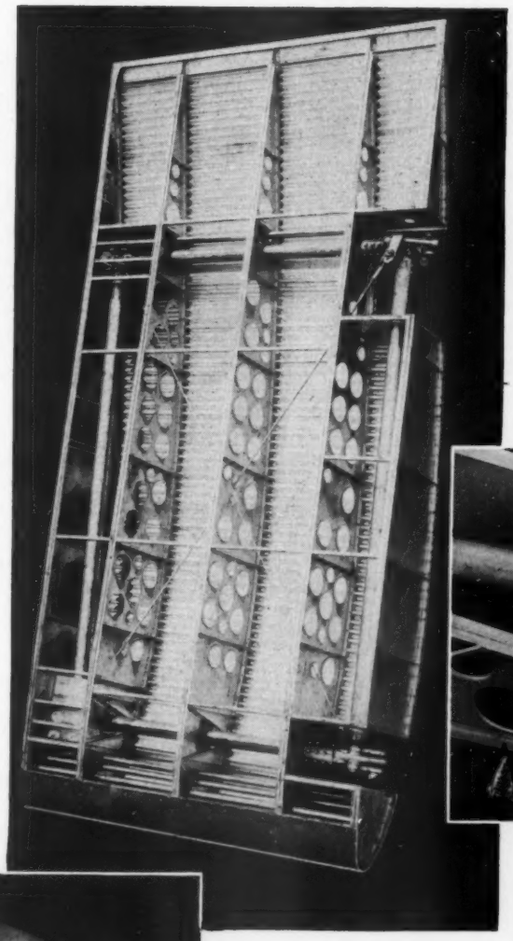
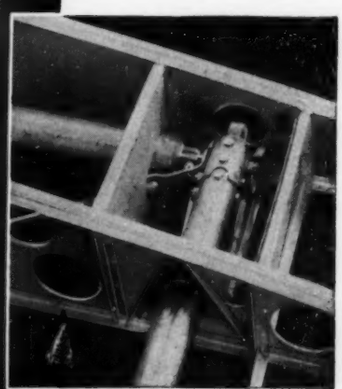
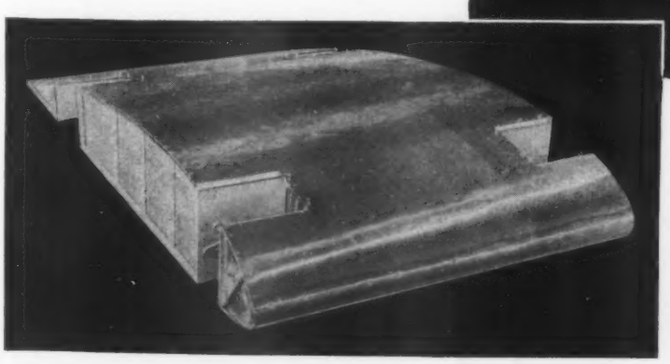
★ These are only the high spots in the exhaustive series of tests which are standard practice in the MARTIN plant. Yet they indicate the extreme care taken to assure for MARTIN planes a high safety factor and the utmost dependability in the air.



Below: Close-up of section of lower inner wing of the Martin PM-1, showing one of the two wing hinge fittings which support the outer wing. In tests these hinge fittings are required to support ten times the maximum load that could possibly be imposed upon them in service.





Above: Full view of one of the lower inner wings of the Martin PM-1, showing details of construction. Tests far more drastic than any usual or unusual condition which could be met in flight are imposed on ibs, braces, and all other component parts.

Left: Complete lower inner wing of the Martin PM-1, covered with anodized aluminum alloy sheet. After being heat treated by special Martin processes, this aluminum alloy sheet has a tensile strength of 55,000 pounds per square inch.

THE GLENN L. MARTIN COMPANY

Builders of Dependable Aircraft Since 1909 ★ Baltimore, Maryland, U. S. A.

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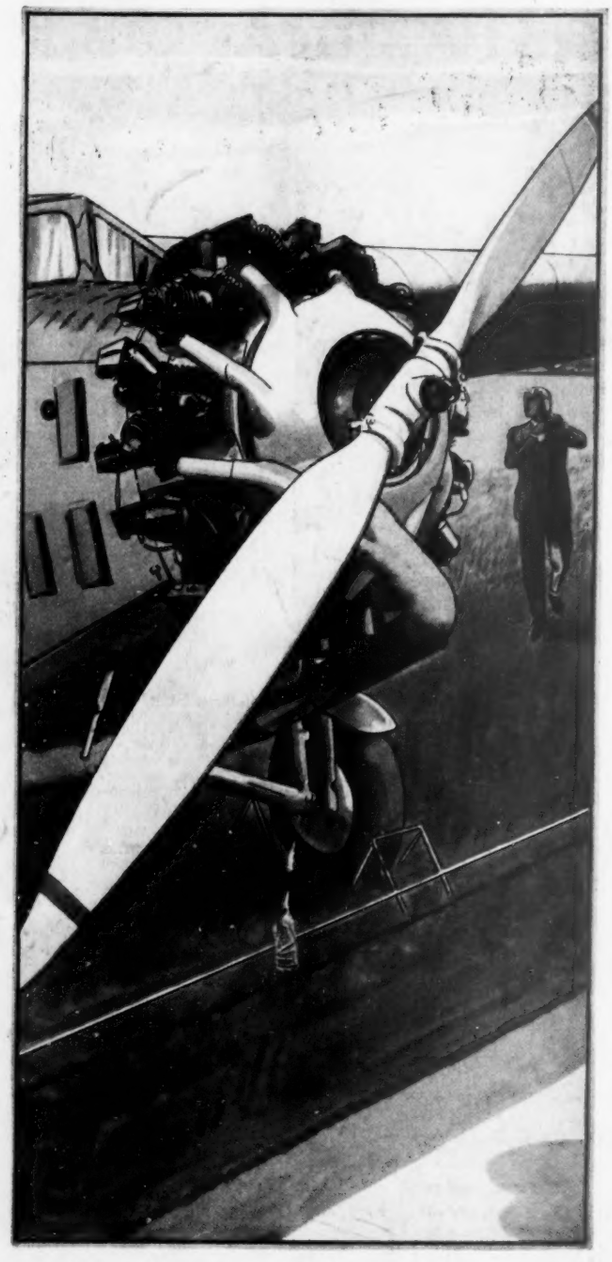
A HUNDRED EXTRA HORSES PULL WITH THE "WHIRLWIND'S" RATED 300!



TO find out what the "Whirlwind 300's" can do, Wright has opened these engines wide and flown them further than around the world without stampeding their power. In fact, at the end of 30,000 miles every engine still turned out more than 100 extra horsepower as smoothly as at the start!

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That's what you get in an engine by Wright . . . enough *surplus power* alone to fly the average plane. Pilots know this by personal tests. Operators by service checks. And passengers know it by smooth, sure, on-schedule travel.

For the striking developments that made these feats possible are, after months of gruelling testing, being put into the regular production "Whirlwind 300" engines.

Cooling area of the cylinder head is 40% increased. A Wright-type spark plug cooler also reduces heat in the head. A new sidewise exhaust port leads gases to the exhaust manifold through a well-finned cast-aluminum elbow. And a completely enclosed but quickly-removable rocker box cover cuts line servicing costs.

Finding new improvements. Proving them. Then putting them into production engines. That's what won world-records for Wright engines—and what keeps them constantly far ahead of the field!

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